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THE MULTIPLE ARCH DAM OF REINFORCED CONCRETE.
BY C. E. GRUNSKY.

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Alphabetical Index to Advertisers, Page 8 **Where to Buy It in the West, Page 9**

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THE MULTIPLE ARCH DAM OF REINFORCED CONCRETE

BY C. E. GRUNSKY.

(The use of reinforced concrete as a building material has made possible the construction of dams which do not depend upon massiveness for their stability. The multiple arch dam is one of the economical methods of construction thus made possible, and this discussion relates to the stresses in this type of structure and the principles which should be followed in its design.—The Editors.)

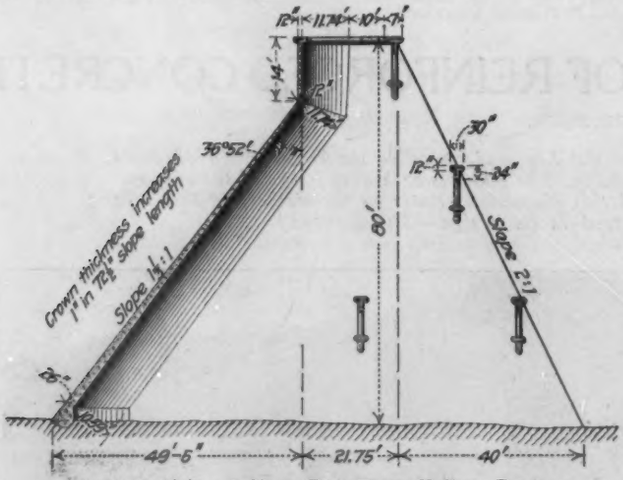
Rear View of Big Bear Valley Dam—This is an Eastwood Multiple Arched Dam, 92 ft. High and 363 ft. Long on the Crest.

The properties of concrete and its permanency as a building material becoming better known, its use is being extended. Combined with iron and steel, so distributed through its mass as to take up the tensile stresses that develop in any structure, it is no longer restricted to use under conditions that subject it to compressive strains only. Its successful use in floor construction and for pipe lines of large dimensions and under high pressure with relatively thin shells, points the way to new principles in the design of many structures.

Where, to withstand water pressure, it has in the past been customary to rely upon the massiveness of structures, the conviction is now irresistible that imperviousness could have been secured in many cases by lighter structures designed with due regard to the

stresses in all their parts. This statement has special application to the design of masonry dams at points where a suitable foundation can be secured.

In recent practice the types of dams which rely for imperviousness upon a comparatively thin membrane or deck, or skin of wood, iron or earth, closing against an impervious foundation and backed by more or less pervious material, are numerous. Concrete has been used but little as the sole reliance for facing high embankments of earth or rock mainly for the reason that concrete has but little elasticity and is, therefore, too prone to rupture under unequal settlement of the material used for its support or under the strains result-



Cross-Section of New Big Bear Valley Dam.

ing from temperature changes. These objections do not apply with the same force to reinforced concrete in which, under ordinary circumstances, there need be no cracking of a character that will menace the safety of a structure. It is reasonable, therefore, to use this material as a facing for rock fill dams.

The only questions to be considered are whether adequate support can be given to such a facing, whether a water tight connection can be made with bedrock and what thickness of concrete is necessary to secure imperviousness at various depths below the water surface.

Of these questions, those relating to the character of the foundation on which the concrete must rest and relating to the required thickness of the concrete deck or facing can be definitely answered on the basis of conditions at the dam site and experiments with the materials of which the concrete is to be made. The remaining question relating to the support of the facing is involved in some uncertainty.

It is evident that this uncertainty would be removed if masonry piers or buttresses were substituted for the loose rock, and this consideration has led to the design of hollow dams and also suggests the multiple arch form of dam.

Some years ago it required courage to advocate the thin shell of concrete that might thus be used as an arch between piers. Now that reinforced concrete may be substituted for plain concrete and the reliability of concrete as an impervious or nearly impervious material is better understood it is quite proper to treat a relatively thin shell of this material as impervious. Many dams have already been constructed on this principle.

Of the dams with a thin concrete face the multiple arch dam is particularly attractive for the reason that all material used in its construction can be brought into service under compressive stresses alone, and that these stresses are determinable with a high degree of accuracy. Rusting of the material used for reinforcement, in case there should be any rusting, will not destroy the stability of such a dam. The following general discussion relating to stresses in multiple arch dams will make clear the principles that should be followed in designing such a structure.

Stresses in Piers of Buttresses and Arches of a Multiple Arch Dam.

In order to obtain a clear conception of the strains in arch and pier of a multiple arch dam, let it first be assumed that such a dam be constructed of material having no weight. The arch may then be regarded as built up of a number of superimposed segments of cylindrical shells with definite thickness.

Let **H** represent the total height in feet; of a dam, to the water surface; **h** the average depth in feet of the ends of a unit increment of the arch below the water surface, that is, depth at the piers; **t** the thickness in feet of the arch unit increment whose abutments are at the depth **h**; **s** the allowable compressive strain in pounds per square inch of the material of which the dam is composed; $\mathbf{t}^1$ the thickness in feet of the pier at the face of the dam at the depth **h**; **R** the large or water face radius of the arch in feet and assume the construction such that the value of **R** is uniform for all depths; α the angle between the slope of the face of the same and a horizontal line; and **L** the distance betwen pier centers in feet.

In such hypothetical cases the thickness of the arch can, for all practical purposes, be determined from the equation:

$$144\,s\,t = 62.5\,h\,R \qquad (1)$$

$$t = \frac{62.5\,h\,R}{144\,s} \qquad (2)$$

Equation (2) is strictly correct for the multiple arch dam with vertical face. It is near enough to the truth for all face slopes likely to occur in practice. For arches with axes on a slope, the value of **t** thus determined will give some excess material at the crown, because the crown is then at less depth below the water surface than the corresponding arch abutment.

The direction of the water pressure on the successive arch rings is normal to the arch axis. The horizontal component of the pressure on any such ring is exactly equal at the pier to that of its neighbor. The component of the water pressure normal to the face of the dam is at right angles to the face line of the pier. Consequently, if the material of which the dam is constructed has no weight the pressure line in the pier will be a straight line normal to the face of the dam and the thickness of the pier at its upstream face will be at the depth **h**:

$$t^1 = \frac{62.5\,h\,L}{144\,s} \qquad (3)$$

For the special case when $R = L$, that is, when the span of the arch is 60 degrees, there will be $t^1 = t$.

In the assumed hypothetical case of masonry without weight, the line of thrust in the piers is normal to the general position of the face of the dam. The outside or downstream edge of the piers should make an angle of 90 degrees with the upstream face line of the pier. Consequently, if the dam has a water slope of $\alpha = 30$ degrees, the downstream edge of the piers would slope away at 60 degrees and if the water face slopes 45 degrees, the downstream edge of piers would also slope at 45 degrees and so on.

To determine the modification, if any, that must be made in the foregoing formulas, or the departures from values determined by them when the weight of the material of which the dam is constructed is taken into account, let it be supposed that by use of the formulas the dimensions of arches and piers have been determined. Unit sections of the pier and adjacent half arches at various depths are then considered as independent structural elements, each required to sustain the water pressure transmitted by the arches to the pier, and to sustain in addition thereto the weight of material. The dam, in other words, is assumed to be composed of a series of superimposed disconnected laminae, each of which extends through the pier and the half-arches, and has the dimension unity measured up and down the upstream face of the pier. The forces are to be diagramed on the assumption that the water pressure will just hold each such unit layer in equilibrium. The resulting pressure lines from the face of the pier down to the base of the dam will have positions for a dam with $\alpha = 60$ degrees, about as shown by the curved lines in Fig. 1. Their inclination is a safe guide to the inclination which should be given to the downstream face or edge of the pier. These lines, while aiding in determining the magnitude and direction of the maximum stresses that are possible in the pier, do not permit of absolutely correct deductions in these matters, because the laminae are not in reality disconnected and the excess weight at the top of the structure, due to requirements of construction and generally also due to the loading resulting from topping the dam with a roadway, would, if taken into account, bend the lines more sharply downward. However, with due regard to the spacing of these lines in the various portions of the pier, they become a guide to its required thickness and they have thus been used in designing the piers, shown on the accompanying diagrams. Each pier has been given two plane sides, so that the preparation of forms is made as simple as possible. There is no departure from the two side planes, except only at the top, where a minimum requirement of two feet in thickness has been assumed, and at the points where buttress supports are planned for inter-pier stiffening arches. In the diagrams lines of uniform pier thickness are shown. They appear as light, broken, parallel lines.

Front View of Big Bear Valley Dam—This dam was built during 1910-1911 at the same cost as for the old dam in the foreground, though the space closed is over one-third larger and the storage capacity three times greater. The new dam has a safety factor twice as great as the old one.

Reinforcement should be provided in both arches and piers in lines parallel with the water slope and as nearly at right angles thereto as practicable. The main purpose of the reinforcement will be to prevent temperature cracks. It is not taken into account in determining the required dimensions of arches or piers. All parts of arches and piers will theoretically be under compressive stress only.

According to the foregoing the formulas (2) and (3) are not strictly true, except only for the crown of

an arch with vertical axis. In practice they may be accepted with confidence, both for the determination of the thickness of the arch at any depth and the thickness of the pier at the water face line (i.e., as it would be if extended forward to the water face of the dam).

Special Case of a Dam 200 Feet High.

By trials not necessary to describe in detail the desirable slope of the water face was found to be about 60 degrees. The top of the dam is supposed to carry a roadway 20 ft. wide at an elevation 6 ft. above the water surface. On this roadway two parapets 4 ft. high are assumed. The upper 22 ft. of the water face

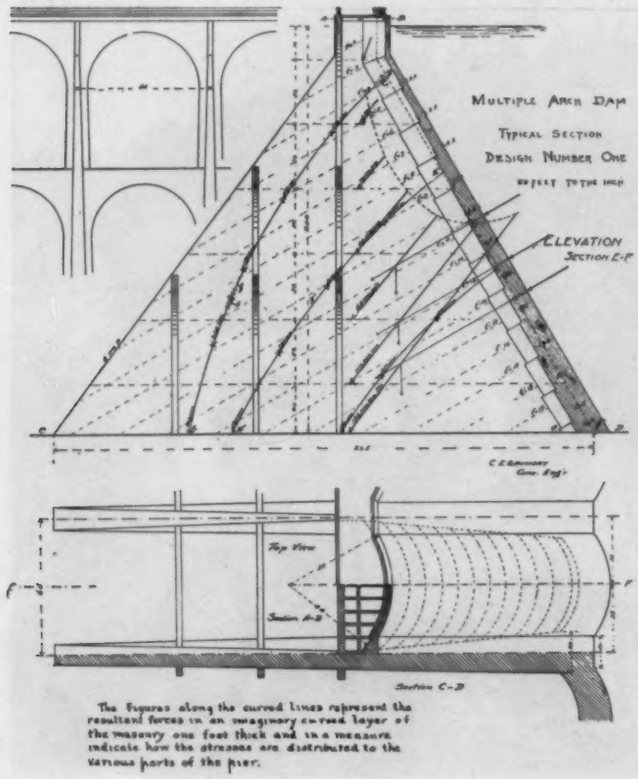

Multiple Arch Dam
Typical Section
Design Number One
Elevation
Section E-F
Top View
Section A-B
Section C-D
The figures along the curved lines represent the resultant forces in an imaginary curved layer of the masonry one foot thick and in a manner indicate how the stresses are distributed to the various parts of the pier.

Fig. 1.

is to be vertical. The minimum thickness of arch and pier masonry is to be 2 ft.

The roadway is supposed, for strain sheet purposes, to be constructed of reinforced concrete, it being assumed that the upper series of stiffening arches between piers, the roadway and the supports and the parapets will be equivalent to an addition of 70 cu. ft. of concrete per lin. ft.

As shown in the sketch, the piers are to be interconnected at about one-third and at about two-thirds of the maximum height of the structure by three sets of stiffening arches 3 ft. thick with 8 ft. depth at the crown. The exact spacing of these arches is to be determined when the structure is located on the ground.

At the deepest point of the stream-bed the slope of the face is to terminate at about the surface of the ground and below that elevation the axis of the arches is to be vertical. In computing strains in the piers the vertical position of this sub-surface section of the structure is disregarded because the same will have adequate support against downstream movement by the natural material or back-fill against which it rests.

The aggregate amount of material in the piers (except for irregularities in the foundation) is independent of their spacing. The distance between pier centers may, therefore, be determined with a view to keeping the masonry in the arches at minimum figures, or to securing especially favorable locations for one or more piers, or finally to keep down the number of piers whereby the cost of preparing the foundation may be reduced.

For the same value of **R** and the same slope of the face, the quantities of material per linear foot of dam in arches spanning 60 degrees, 120 degrees and 180 degrees, are to each other as 1 to 1.15 to 1.50.

It is interesting to note in this connection that for a given spacing between piers, and material of construction such that any thickness of arch is allowable, the quantities of material per linear foot of arch for the 60 degrees, 120 degrees and 180 degrees arches would be to each other as 1.45 to 1.00 to 1.15. But the thickness of the arch when determined solely from economy of material and on arbitrary pier spacing is not acceptable. The thickness should not be determined without due regard to the requirement of imperviousness. When its thickness at various depths on this latter basis has been determined, a proper application of the allowable stress of compression will give the value of **R**. The adoption of the economical arc of about 60 degrees will then make the pier spacing about equal to this radius of curvature.

In the absence of data based on experience, but with the knowledge that well made concrete in reinforced pipes with 6 to 10 in. shell thickness is in use under pressure up to 80 ft., it appears that comparatively thin arches could be used with safety. But concrete is a material which by nature of its production may lack homogeneity. In structures of such importance and magnitude as a high dam, it should always be used with a reasonable factor of safety.

With this in view, to meet fully the requirement of imperviousness, it is believed that the concrete in the arches should have a thickness at least equal to one-twentieth of the depth below the water surface.

As it is quite possible that it may be found desirable to prescribe even a greater factor of safety for a dam 200 ft. high against leakage through the masonry than indicated by this formula ($t = \frac{h}{20}$) the dam, Fig 1, has been planned with an arch thickness everywhere at least equal to one-sixteenth of the depth below the water surface.

For $h = 192$ and $t = 12.5$ and a value of $s = 330$ lb. per sq. in., the value of **R** and consequently, the pier spacing will be about 50 ft.

A first tentative design for a dam about 200 ft. high was, therefore, made with 50 ft. between center lines of the piers and with the outer or large radius of the arches 50 ft.

While these dimensions, and particularly the thickness of the arches are tentative, they are in accord with sound engineering practice and, if in the final design any change is made, it will be in the direction of a reduction of the proposed thickness of the arches with corresponding decrease in the arch radius.

It may be repeated that the perviousness of concrete will be the principal factor to be considered in this connection and that before reaching final conclusions relating to minimum allowable arch thickness, some experimental data with the particular materials that are to enter into the composition of the concrete may have to be secured.

Whether the piers should not be spaced further apart than 50 ft. has been given consideration. Wide spacing is desirable because thereby the number of piers is reduced and the work of excavating for foundations is somewhat simplified. But there is no saving in masonry as a result of wider spacing. It is therefore, questionable whether the advantage of fewer piers off-sets the disadvantages of the longer arch spans. The longer the arch the greater will be the departure from straight line work, which is of importance as it simplified the closing against bedrock. The masonry in the arches, too, will increase the quantity either with **R** at 50 ft. and a relatively longer arch, or with a larger radius and a corresponding increase of the thickness of the arch.

On the typical design, Fig. 1, as a result of giving weight to these considerations, a pier spacing of 66 ft. between centers has been assumed for a dam 200 ft. high. The upstream face of the arch will cover a span of 60 degrees, if the upstream face of the piers between arches is made 16 ft. By adopting some such scheme as keeping the upstream pier face of uniform width from top to bottom, a uniformity of forms will be secured for each unit of the upstream face of the dam that will facilitate construction.

The downstream or concave surfaces of the arches may be treated as a section cut out of the surface of a cone frustum, the radius of curvature gradually decreasing from top to bottom, or the thickness of the arches may be made uniform throughout successive depth increments of selected magnitude. In the typical design, Fig. 1, there is an increase of thickness shown at each additional 16 ft. below water surface.

In the design No. 2 (Fig. 2) there is a gradual increase of thickness from the minimum, 2 ft. at 16 ft. below the water surface, to 13.5 ft. at 200 ft.

The arch thickness for $\mathbf{R} = 50$ ft., will be as follows, under the offset plan of design No. 1.

Arch thickness for $\mathbf{R} = 50$ ft.

Top of dam to	16 ft.	below water surface,	2 ft.
16 ft. to	32 ft.	below water surface,	2.5 ft.
32 ft. to	48 ft.	below water surface,	3.5 ft.
48 ft. to	64 ft.	below water surface,	4.5 ft.
64 ft. to	80 ft.	below water surface,	5.5 ft.
80 ft. to	96 ft.	below water surface,	6.5 ft.
96 ft. to	112 ft.	below water surface,	7.5 ft.
112 ft. to	128 ft.	below water surface,	8.5 ft.
128 ft. to	144 ft.	below water surface,	9.5 ft.
144 ft. to	160 ft.	below water surface,	10.5 ft.
160 ft. to	176 ft.	below water surface,	11.5 ft.
176 ft. to	192 ft.	below water surface,	12.5 ft.
192 ft. to	200 ft.	below water surface,	13.5 ft.

These dimensions are based on an allowable compressive stress in the concrete of 330 lb. per sq. in. and no account is taken of the added strength due to the reinforcing steel.

The thickness of the piers as they result from an interpretation of the strain diagrams for a pier spacing 66 ft. between centers and $\mathbf{R} = 50$ ft. would be as follows:

Thickness of Piers at Water Face Line.

16 ft. below water surface	3 ft.
32 ft. below water surface	4 ft.
48 ft. below water surface	5 ft.
64 ft. below water surface	6 ft.
80 ft. below water surface	7 ft.
96 ft. below water surface	8 ft.
112 ft. below water surface	9 ft.
128 ft. below water surface	10 ft.
144 ft. below water surface	11 ft.
160 ft. below water surface	12 ft.
176 ft. below water surface	13 ft.
192 ft. below water surface	14 ft.
200 ft. below water surface	15 ft.

From these points at right angles back from the face line of the piers the thickness of the piers should be uniform.

The downstream edge of the pier is to have a slope of 4 on 3.

Based on the dimensions here indicated, but without allowance for the masonry required to close against bedrock or to properly transmit strains to bedrock, or to extend cut off curtains into bedrock, the concrete required will be about as follows:

Contents in cu. ft. per lin. ft. where $\mathbf{R} = 50$ ft $\mathbf{L} = 50$ ft., $\mathbf{s} = 330$ lb. per sq. in. and $\alpha = 60$.

Contents in Cubic Feet per Linear Foot.

Height to water surface.	Contents.	Height to water surface.	Contents.
16 ft.	125 cu. ft.	128 ft.	2170 cu. ft.
32 ft.	215 cu. ft.	144 ft.	2890 cu. ft.
48 ft.	350 cu. ft.	160 ft.	3660 cu. ft.
64 ft.	550 cu. ft.	176 ft.	4550 cu. ft.
80 ft.	840 cu. ft.	192 ft.	5580 cu. ft.
96 ft.	1200 cu. ft.	200 ft.	6150 cu. ft.
112 ft.	1630 cu. ft.		

These estimates of quantities were made for a pier spacing of 66 ft. (Fig. 1), but are substantially correct, too, for a pier spacing of 50 ft.

The design, Fig. 1, was made with a water face radius of 50 ft. and a pier spacing of 66 ft. The allowable compressive stress of concrete was taken at 330 lb. per sq. in. Both surface of the arches in this design are cylindrical, the concave surface being offset where the arch thickness changes.

After the design shown in Fig. 1 had been made, further study indicated that a dam with a somewhat steeper face than 60 degrees with the horizontal would require a little less masonry. This led to the preparation of a design with the upstream face sloping two on one or $\alpha = 63$ deg. 26 min.

The pier spacing in this design, Fig. 2, was made 60 ft. between centers, the upstream face of the arches was given a radius of 44 ft. and the allowable compressive stress of concrete was taken at 300 lb. per sq. in. In this design the concave surface of each arch is shown conical.

Although the factor of safety is 10 per cent higher for design No. 2 than for design No. 1, the steeper slope of the upstream face and some minor modifications of the pier design more than offset the greater quantity of masonry that results from the use of the low allowance for compressive stress. Consequently, the cubical contents for dams of various heights, exclusive of masonry in footings, or masonry required to key the structure to bedrock at an allowable stress of 300 lb. per sq. in. should be somewhat lower than has been estimated for the design shown in Fig. 1.

Cubical contents for the second design. Fig. 2, in cubic feet per linear foot of dam:

Contents in Cubic Feet per Linear Foot.

Height to water surface.	Contents.	Height to water surface.	Contents.
16 ft.	130 cu. ft.	128 ft.	2020 cu. ft.
32 ft.	200 cu. ft.	144 ft.	2670 cu. ft.
48 ft.	320 cu. ft.	160 ft.	3380 cu. ft.
64 ft.	480 cu. ft.	176 ft.	4220 cu. ft.
80 ft.	760 cu. ft.	192 ft.	5180 cu. ft.
96 ft.	1110 cu. ft.	200 ft.	5740 cu. ft.
112 ft.	1510 cu. ft.		

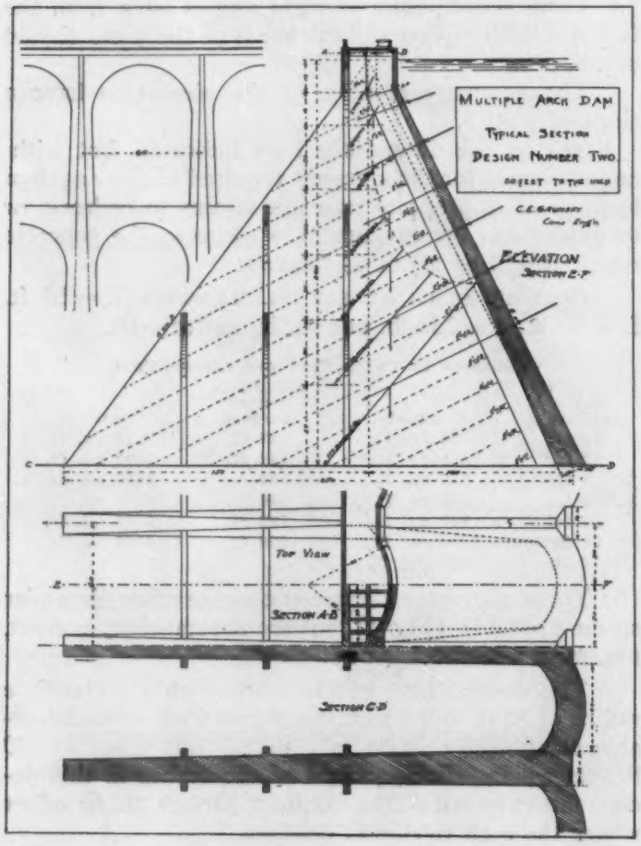


Fig. 2.

(Fig. 2. Curved lines X Y Z and X^1 Y^1 Z^1 indicate the positions of slices or layers of concrete in equilibrium, if regarded apart from the rest of the structure, one foot thick at the water face (at points X and X^1. The figures denote pounds of pressure, in approximate values, at the points where noted, for unit layers, which are assumed to extend from a vertical plane passing through the axis of one arch to the vertical axial plane of a neighboring arch. Each layer, therefore, represents two half slices of adjoining arches and a slice of the intermediate pier. If the space on the water face between the points X and X^1 be assumed to be thus subdivided into one foot layers and each slice from X toward Y is gradually increased or decreased in thickness according to whether the successive pressure lines X Y Z, X^1 Y^1 Z^1 etc., separate from or approach each other, and the space between two successive pressure lines at any point, as at Y, be called d, then the relation between pier thicknesses at A and at B can be preliminarily approximated from the equation

$$t^{11} = \frac{t^1 p^1}{d p}$$

where t^{11} is the pier thickness at Y; t^1 is the pier thickness at X; p_1 is the pressure to be cared for at Y and p is the pressure to be cared for at X. In the design shown in Figs. 1 and 2, the shape of the pier was determined from the allowable stresses at its base; a minimum pier thickness of 2 ft. at the top, and from the requirements that the piers have unbroken flat sides. The dimensions as shown would provide a larger safety factor for points near the top than near the base of the structure.)

The total forces resulting in each pier from a combination of the water pressure and the weight of masonry are shown in each design at various horizontal planes.

It has been assumed that a driveway will be required on top of the dam. When this is not required, minor modifications of the diagram will result.

The typical dam above described, illustrated in designs, Figs. 1 and 2, has been dimensioned, as stated, on the assumption that compressive stresses are not to exceed 330 lb. per sq. in. in the first design, nor 300 lb. in the second. This may, by some engineers, be considered a severe requirement, as concrete is frequently used in important structures under compressive stresses as high as 600 lb. per sq. in.

The United States Reclamation Service allows a compressive stress of 600 lb. per sq. in. in reinforced concrete. Dams of the Ambursen (hollow concrete) type are being designed and built with an allowed compressive stress of 600 lb. as, for example, the dam recently completed across La Prele River, 15 miles west of Douglas, Wyoming, which has a maximum height of 135 ft.

A recent design of an "all true arch" concrete dam 50 ft. high for the Aqua Pura Company in New Mexico, by Metcalf & Eddy of Boston, is based on an allowable compressive stress of 350 lb. per sq. in. and the possibility is indicated that, when raised to 95 ft. the compressive stress might, under certain conditions, reach 315 lb. per sq. in.

In other words, the designs of the Multiple Arch Dam here presented are based on a relatively higher factor of safety than is frequently prescribed, and any excess in this factor of safety, above the factor in common use is purely a safeguard against such indeterminate conditions as prevail during earthquakes.

Should it be determined that compressive stresses up to 400, 500 or 600 lb. are sufficiently conservative, in view, perhaps, of the increased strength resulting from the reinforced steel, then modifications can be made in the suggested dimensions which will materially reduce the total concrete required.

Before determining the allowable maximum stress for any structure of magnitude, experiments with the materials to be used, entering into the composition of the concrete, should be made. It is probable that with a compressive stress of only 400 lb. the factor of safety will be six to ten, while with 600 lb. it would be three to five, plus any additions that may be made for the added strength of the reinforcement steel.

The inter-pier stiffening arches and their buttress-like supports shown in the designs, are not planned to add strength to the dam against water pressure, but are, like the reinforcing steel and a high factor of safety, a safeguard against damage by such indeterminate forces as may be acting on the structure during earthquakes.

Points of Merit.

No part of the dam will be subjected to other than compressive stress. Internal hydrostatic pressure can be rendered impossible by a system of drainage.

All points of both sides of the arches can be made accessible without extensive excavation, so that if any leak around the concrete through defective bedrock should occur, the leak can be traced from the downstream side of the arches without emptying the reservoir, and not until the work of stopping such leak shows it to be necessary, need the reservoir be emptied.

The structure has all the flexibility required to adjust itself in all parts to expansion and compression, resulting from temperature changes and from hydrostatic pressure.

During construction the water of the tributary watershed can be passed through one or more openings left in the masonry of the arches, which need not be closed until the dam has otherwise been completed. Risk of damage by high water during construction is thus eliminated. The structure by reason of maximum elasticity obtainable with the materials used in its construction will have sufficient flexibility to be classed as possessing a maximum degree of safety against damage by the tremors of earthquakes.

The reinforcement which has been prescribed is not necessary to met the static stresses resulting from water pressure and weight of masonry, but is provided as a safeguard against damage by temperature changes and earthquake stresses.

The factor of safety can be selected with a degree of certainty rarely possible in any other type of structure of equal magnitude.

The foundations on which the piers rest should receive only a safe load, this being regulated by width of footings.

It remains to be said that the Multiple Arch Dam is not adaptable to every dam site. This type of dam can come under consideration only where the foundation is suitable, where it is possible to cut off subsurface flow of water by means of a comparatively thin curtain wall, and where there is good support for the piers. The dam is out of consideration when the dam site is in a narrow-canyon which can readily be closed by a single span arch. It is best suited to localities where the bedrock is massive and hard and where the strength of the dam is more than three times its greatest height.

UNDERGROUND HOISTING AND COMPRESSOR STATION.

There was recently placed in operation by the Silver King Coalition Mines Company, whose mines are located at Park City, Utah, what is perhaps the largest and most unique underground hoisting and compressor station in the world. It is located 1670 ft. below the surface and has been made possible only through the fact that its entire equipment is electrically operated.

This underground station has been installed to provide hoisting and compressed air service for a new shaft on the Silver King Mine from which shaft some of the ore bodies of this company's property can be worked more advantageously.

The station contains three rooms or chambers, occupying a floor space of approximately 3600 sq. ft. The walls and roof are of heavily reinforced concrete finished in smooth white cement plaster. The air for the shaft and construction of the station has been supplied by three large compressors from the surface. A motor driven compressor on the Sullivan W.-J.-3 angle compound type has been installed which supplies air for the station and shaft and serves as a booster on the main pipe line, this compressor having a capacity of 900 cu. ft. of free air per minute.

The motor driven hoist for operating the cages in this shaft is located in one of the three rooms of the station and is operated by 600 volts d.c. from a 250 k.v.a. synchronous motor—generator set also located in the underground sub-station, which obtains its power from the surface transmission lines through a 2200 volt cable.

The engineers in designing this plant have arranged it so that the air compressor which is used as a booster to the main air lines utilizes the electric current during the intervals when the hoist is not running, thus eliminating the peak loads which would be occasioned by the super-imposition of the demands of the two machines, and which would materially increase the price paid for electric power.

FACTORY SAFETY SUGGESTIONS.

In response to a general request from the employers of California for suggestions which will enable them to guard machinery so as to prevent accidents, the Industrial Accident Commission has issued a brief statement covering certain fundamental requirements relative to safety as observed in other states and in foreign countries.

Belts and Pulleys.

Belts and pulleys should be so located, wherever possible, as not to be dangerous to employes, or should be properly enclosed, fenced or otherwise protected. In all cases the point, if exposed to contact, should be guarded where the belt, rope or chain runs on the pulley, sheave or sprocket.

Guard all horizontal belts, ropes or chains driving machinery or shafting, 7 ft. or less from the floor, ley, sheave or sprocket.

In guarding overhead belts or rope drives, unless so guarded that persons cannot pass under them, the width of the guard should not be less than the width of the belt or rope drive and the length should not be less than the distance between the outer faces of the two pulleys. It should cover outer faces of the two pulleys or sheaves and extend upward to such a point, and be attached in such a way that in case the belt breaks, it will withstand the whipping force of the belt.

In rooms, or parts of rooms used exclusively for transmission machinery, such as the ground floor of saw mills and the basements of paper mills or flour mills, it has been found practical to define certain passageways for the use of oilers and millwrights and to guard the pulleys, belts and shafts along these passageways.

All loose pulleys should be furnished with a permanent belt shifter, so located as to be within easy reach of the operator. The belt shifter should be so constructed as to make it impossible for the belt to creep from the loose pulley back on the tight pulley. All belt shifters should be equipped with a lock or other efficient device to prevent the shifter from being accidentally shifted.

Pulleys should be so placed as to allow the width of the belt between two pulleys, or between the pulley and the shaft hanger, or a hook should be provided, or a guard placed adjacent to the pulley to prevent the belt from leaving the pulley.

Set Screws.

All set screws on moving parts, where exposed to contact, should be countersunk or protected by a solid collar, or a headless set screw should be used. No part of the screws should project above the surface.

Shafting.

All revolving shafting less than 7 ft. above the floor lines should be boxed or railed off, as revolving shafting is always a menace to those whose clothing might come in contact with it.

Projecting keys in shafting should be guarded or cut off.

In rooms, or parts of rooms used exclusively for transmission machinery, such as the ground floor of saw mills and the basements of paper mills or flour mills, it has been found practical to define certain passageways for the use of oilers and millwrights and to guard the pulleys, belts and shafts along these passageways.

Gears.

All gears. where exposed to contact, should be entirely enclosed or equipped with a flange guard which will enclose the teeth of the gears. On large gears, such as those on heavy shears and punches, the guard should be such as to cover them to a height of 7 ft. above the floor.

Where it is impracticable to cover the gears, a boxed frame of metal or wood should be installed, completely shutting off the machinery gears. It is necessary that all guards should be kept in place except when the machinery is shut off for repairs.

Grinding Wheels, Hoods and Guards.

Wheels should be handled with the greatest care in unpacking, storing, delivering, etc.. and should never be left standing on the ground or wet places.

Great care should be used in mounting wheels; never force a wheel on the arbor. It is advisable to use relieved flanges, compressible washers between wheel and flange, and to obtain a perfect bearing at the outer edge of the flange. Vibration should be avoided at all times.

A protective hood, or guard, should be provided, wherever practicable, and the nut on the end of the arbor should be guarded. Cast iron hoods should be avoided as they have often been known to break when struck by a bursting wheel. The guard should be adjusted close to the wheel and extended over the top of the wheel to a point thirty degrees beyond a vertical line drawn through the center of the wheel. Wheels used for wet grinding should not be left partly immersed in the water.

Foremen should examine every emery wheel each day and see that the bearings are tight and well oiled, and that it is operated within proper speed limits, and is safe in every way.

The revolutions per minute at which wheels are run is dependent on conditions and in actual practice. Wheels are run at surface speeds of from 4000 to 6000 ft. per min. up to as high as 7500. It is recommended that for most grinding operations surface speeds should not exceed 6000 ft. As a wheel wears down the speed is increased to maintain the same surface speed and great care must be exercised when new wheel is provided to avoid over speeding.

TABLE OF GRINDING WHEEL SPEEDS.

Table of Grinding Wheel Speeds.

Diameter of wheel. In.	Rev. per Min. for surface. Speed of 4000 ft.	Rev. per Min. for surface. Speed of 5000 ft.	Rev. per Min. for surface. Speed of 6000 ft.
1	15279	19099	22918
2	7639	9549	11459
3	5093	6366	7639
4	3820	4775	5730
5	3056	3820	4584
6	2546	3183	3820
7	2183	2728	3274
8	1910	2387	2865
10	1528	1910	2292
12	1273	1592	1910
14	1091	1364	1637
16	955	1194	1432
18	849	1061	1273
20	764	955	1146
22	694	868	1042
24	637	796	955
26	586	733	879
28	546	683	819
30	509	637	764
32	477	596	716
34	449	561	674
36	424	531	637

Ladders.

Ladders should, wherever possible, be stationary; if movable, they should be provided with either sharp points at the foot, or wide, rough surface feet so as to prevent slipping. Ladders for use in oiling overhead shafting, where necessary to rest same on the shafting, should be arranged to hook over said shafting.

Stairways.

Stairways should not be built of a sharper angle than fifty degrees. For over fifty degrees, ladders should be used instead. All stairways should be equipped with hand rails. Where the stairway is not built next to a wall or partition, rails should be placed on both sides.

Platforms and Runways.

All elevated walks, runways or platforms, except on loading or unloading side of platforms, if four feet or more from floor level, should be provided with a guard rail. A toe board should be provided to prevent material from falling off.

Passageways—Keep Clear.

All passageways and gangways should be kept smooth and in good repair and free from nails or obstructions over which persons may stumble and fall.

Swinging Doors—Windows.

All swinging doors in stairways and all doors swinging both ways in general passageways should be provided with windows. One window should be provided for each section of double swinging doors. Both sides of the doors should be provided with adequate light, either natural or artificial, during the hours of active operation in the department in which said swinging doors are located. The windows must be kept free from dirt or other obstruction to the vision.

In order to accommodate boys or girls, the bottom of the windows should not be more than 48 in. from the floor. The size of the window which is recommended should be not less than 8 in. by 24 in. Guards should be placed over the window to protect the glass from being broken by protruding parts on trucks, etc.

SELLING ELECTRIC SERVICE

REQUIREMENTS FOR SUCCESS IN SELLING.

BY R. I. CARRUTHERS.

(From a paper presented recently at a meeting of salesmen of the Southern California Edison Company.—The Editors.)

Mr. J. H. Pieper's suggestion "Respect your competitor and show him ordinary courtesy," is one which is bound to gain for you the respect and confidence of your prospective customer. You must remember that the purpose of your competitor is the same as your own, a livelihood. Possibly his goods are not of the same quality as yours, nevertheless he is entitled to a square deal.

To be a good salesman is to be a dictator. The real salesman is the man who brings buyer and seller together. His services are most essential in the commercial world. He is the one whose efforts result in income.

A successful salesman must believe in his firm and, also, in the goods he has to sell. He must have confidence in and study himself as well as his customer. He must try to get his man interested to a point where he will ask questions, then his knowledge on the subject and his enthusiasm will gain confidence and an order will soon be forthcoming. To me the essential qualification of a successful salesman is honesty. He should be careful not to overestimate his goods or make any promises that his company will not back up. If he is honest he will not get in bad with his customer or his company.

The salesman must be a man of resource. He must know how to overcome objections which may be raised. In other words, he must be prepared to meet all conditions.

We all have our difficulties in getting business. Sometime ago I called on a competitor's customer who had taken a new store, and as we had secured the business in the building before, I was most anxious to obtain his application. My request for an interview was promptly refused, with the statement that his business relations with the other company had been satisfactory and he would continue with them in any location he might have.

As I turned to leave, a saying of Orison Swett Marden flashed across my mind, "I will find a way or make one." After thinking over the matter, I went to a telephone and called my prospect. He informed me that it was useless to take his time and mine as he had definitely decided to continue with the other company. I still persisted and succeeded in making an engagement for the next day, when his objections were overcome and his business secured.

The fundamental principles of successful business are system and organization. Were it not for these two principles it would be impossible for a company to meet the requirements demanded of them. Each department of the company must have its system and organization, under the supervision of a department head, whose duty it is to simplify the system and make it efficient.

These two principles, system and organization, are most necessary in the sales department. The first, to keep in close touch with prospective customers and see that all orders and applications are carried out with expedition. To accomplish this, co-operation is most essential among salesmen themselves. We must meet one another on equal grounds and, if neccessary, be willing to lay aside personal advantage, where doing so would be for the best interest of the company. It is not possible for a man to harbor petty jealousies and be true to himself or the company he represents.

Heads of departments must co-operate, not only to increase the efficiency of their own departments, but the company's service as well. It is my opinion that this co-operation should not be done in a haphazard way. I have known of cases where concerns have lost valuable business because of loose methods. In my judgment it is not wise for the head of one department to exercise control over the men of another department while the motives used may be the very best, sometimes the results are far from satisfactory.

Each salesman must have a system and organization by which he obtains best results. A salesman can organize his well satisfied customers into a sales department of his own. His aim should be to gain the respect and confidence of these patrons, thereby creating for himself an advertising medium of inestimable value. A well satisfied customer will do as much talking as a dissatisfied one. It has been my experience that well satisfied customers have been able to reach and obtain applications for me that I would not have been able to obtain myself.

It is a well known fact that private corporations have been much more successful and have established a greater degree of efficiency than municipally owned concerns. The reason for this is that private corporations have a well defined policy which they rigorously carry out and improve from year to year while with the other the policy changes with every political change in the city. We have a good example of this in one place where the municipal plant has been able to exist only because of radical legislation favoring it as against the commercial company.

In order that a company may carry out its own well defined business policy, not only for the present but also in the future it is absolutely necessary for each department to have and maintain its own smooth working organization. A broken cog in the smallest wheel in a watch or one dry bearing in a factory lineshaft may finally hinder the whole works.

A man must not be satisfied with his day's work, simply because he has turned in three or four applications, but must strive to keep a list of live prospects some of which are maturing every day.

A company appreciates its salesmen and will take care of them if they are good producers.

Electric smelting has been economically demonstrated for production of ferro-tungsten at a cost of 3.46 kw.-hr. per lb. and it is claimed for the Johnson electric furace for the treatment of zinc ores that a power consumption of 3.1 to 4.5 kw.-hr. will produce a pound of spelter.

THE THREE TYPES OF MANAGEMENT.

BY E. ST. ELMO LEWIS.

(This is the second of a series of three articles on Management by Mr. Lewis, who is President Detroit Executive's Club and advertising manager Burroughs Adding Machine Company. The first article in this series appeared in this Journal for May 30, 1914.—The Editors.)

Systematic Management.

System is the rut in which some men are proud to live, and one in which the thoughtless stay without fear of serious catastrophe.

System at its worst, affords the incompetent and indifferent a nice comfortable, easy way of doing things. They progress along the road that has already been marked for them, beaten down and rut-plowed by the wheels of a progress gone before. Automatically, every New Year's Day, salaries are increased a few dollars a week, to the automaton as well as to the thoughtful worker.

By the management each is checked up, and if he has followed the system, he is ignored, but if not, he is called down. Each has learned a set, prescribed way of going through his work until, as the youngster said, "he could play the piano with his eyes shut." Under a systematic management a man doesn't have to think, but he does something and remembers.

A great many go through their work just as they eat their meals. They eat them whether they want them or not. So they do their work whether it is useful or not.

When the President's Efficiency Commission investigated the government department at Washington, it found that government workers were making copies of original documents laboriously by hand. By the introduction of a photographic process of making these copies, a 75 per cent saving of clerical time and 90 per cent in cost was effected; $242,000 a year was saved in the handling of public documents. It was estimated that another $850,000 could be saved annually if the departments would properly standardize the handling and filing of correspondence.

The same discovery applies to the majority of business houses. Each department stands alone. To all intents it is separate business. This department files correspondence one way, this one has another that one still another. If four or five departments have correspondence with the same customer, or prospect, even about the same thing, it is only rarely that the complete correspondence can be brought together without a very great deal of difficulty and trial. Why? Is it not because the management does not see the business as a whole, however thorough may be its grasp of details?

The systematic type of manager is a decided improvement on the rule-of-thumb type. The systematic type recognizes that there are some better methods of getting information about what is going on. He aims to find what is a good way to do things by comparing the results of the good, bad, and indifferent methods of the past. He is making the first step toward finding out the facts about his business. The systematic type of manager has one drawback which is so common as to be almost universal—he is still thinking about things and not about people. To him a system is a chart of accounts, or a bunch of cards, or a vertical file, or a loose-leaf ledger with its accompaniment of books and forms and ideas about their handling, but still it leaves out the human element. He continues to believe that the man element is the uncertain, the unsystematic, the untrainable element. He does not think about the training of men but simply forces them into the grooves of handling a thing in a so-called systematic fashion. He makes them what he thinks they are—automatons.

System is on the contrary, a mechanical means to a humanizing end. Its primary purpose is to raise efficiency, and a system that doesn't raise efficiency is fallible, weak, impotent, in the way and a nuisance.

The purpose of a system is:

To keep a true record of what has actually happened.

To keep this record in such terms that the manager may readily translate it into the most productive action.

To insure a reliable, immediate, and accurate record, in order that the manager may determine standards relative to the practice of work, and the conditions surrounding the work, and the operation and their sequence, and fix an adequate reward for the best work.

In the highly systematized type of management the man gets caught in the net of a pre-determined method of following the work, and can make no change from it, without dislocating the whole business routine.

How often have you heard when you go into a retail store and you ask them to do something—"Well, we have never done it that way?" I once made a purchase of some hundred odd dollars in a jewelry store and asked them to deliver the purchase to a steamer. The clerk said that "The delivery doesn't go out until three o'clock." I had to have it delivered at two. In his routine way of thinking it never occurred to the clerk that he could have a special messenger do the delivering and even the head salesman had to "see if it could be done."

Harrington Emerson tells the story of a systematic government official. When he was living in Germany, there were only four official religions — Reformed, Lutheran, Catholic and Jewish. When Mr. Emerson was filling out the census blank for his father's family, he told the census official he wasn't a member of either of these four faiths, but he was told that he had to choose one of them or else be fined. Of course he chose.

In a business with which I was at one time connected there was a certain chart of accounts arranged, and you had to select which of these accounts a disbursement was to be charged. New conditions arose, but the chart of accounts remained the same. Items, for instance, such as were used for the development of the sales organization were charged to advertising accounts, and the management of the company, therefore, got an entirely erroneous idea of the amount of money it was spending for advertising. Nearly a sixth of the amount of money charged to the advertising accounts never even remotely affected the state of mind of the prospective purchaser. The consequence was that the chart of accounts ran the business, and not the business the chart of accounts.

The systematic type of mind constantly falls back for precedent—it is traditional. H. G. Wells, in his thought-provoking book, "The Discovery of the Future" hits off this type of mind remarkably well.

The systematic type of mind:

One might speak of as the legal or submissive type of mind, because the business, the practice, and the training of a lawyer disposes him toward it; he of all men must adhere constantly to the law made, the right established, the precedent set, and consistently ignore or condemn the thing that is only seeking to establish itself.

The efficient type of mind:

I might for contrast call the legislative organizing, or masterful type, because it is perpetually attacking and altering the established order of things, perpetually falling away from respect for what the past has given us. It sees the world as one great workshop and the present is no more than material for the future, for the thing that is yet destined to be. It is in the active mood of thought, while the former is in the passive; it is the mind of youth, it is the mind more manifest among the western nations, while the former is the mind of age, the mind of the "Oriental."

Now, the important thing in management is to realize that we need the strenuous, we need the systematic, and we need the efficient. We need strenuosity to help fix quantity standards, because when the strenuous man is properly guided and handled, he gets a maximum quantity efficiency. But he must be guided.

The systematic type furnishes these reliable records by which we keep track of the efficiency, find it out and establish its standards. But left to himself without guidance, the systematic type of man runs to seed. He becomes petrified in the attitude of changeless superiority. It is only the efficient man that can be left alone, because he will not leave anything alone.

The systematic man, of course, is the stand-pat and conservative mind at work. He prefers to write history rather than prophecy. His mind is set towards the setting instead of the rising sun. He compares today's result with yesterday's result, instead of comparing it with the ideal standard of tomorrow.

The systematic manager inevitably curtails initiative in the plant, for he sets wage limits instead of work limits. He is not concerned about the value so much as he is concerned with the price.

The efficient man is after what we shall do to be perfect. The systematic man is content if he has properly taken care of today in comparison to yesterday. The efficient man is principally concerned in seeing that tomorrow is taken care of in order that to-day will automatically be looked after.

Place the systematic man in charge of your cost work. He is perfectly content if he can devise a system that will attach a string to every dollar, with the consequence that in the hands of the small systematic man, a cost system rarely gives costs, though it produces a lot of figures.

The great fallacy in costs, as some of the efficiency experts have pointed out, is to generalize from the whole to a part, to apply data covering a ten year period to a lesser period, down to a day. Averages are the pitfalls of the system-mad cost accountant.

"The average temperature, or rainfall, ought not to be taken as the weather indication for an outing," is the witty way Mr. Emerson has put this failing. In his book he brings out one very important item by a very vivid comparison. There is a difference between expense and cost. If a salesman on the road paid 25 cents for a cigar with a hundred dollar bill and neglected to get the change, the trip cost you $100, but the expense was only 25 cents for the cigar.

The systematic cost man wants only to know what becomes of the money the material and the work where it has gone.

The efficient man wants to know what you have gotten for the money, and vitally important, if what you received in return for the money is worth the price. We have crude so-called cost systems which do not reflect the activities of a business at all. Merely because a man is systematic, merely because he has a system, is no indication that the system is telling him any usable facts about his business.

It is important therefore, in the establishment of a cost system to pre-determine what you want it to do.

You can't let a cost system just grow.

If you do let it grow, it will grow in many ways that will be expensive and bristling with misinformation pitfalls for your unwary judgment. Put in a cost system by all means. Bring to bear upon the problem the same concrete information, skill, experience and attention to scientific detail you would in making an installation of an electric power plant, or a transmission system, or putting up a new factory building.

As a matter of fact, what do you know about the matter of costs? What do you want a cost system to tell you? If you want to have a cost system to help produce a greater efficiency, then you want it to aid in a real managerial function. If you want it merely as a supplementary historical record to be tied into your accounts, then a mere cost system will do.

But make no mistake, that kind of a cost system will give precious little aid in raising the efficiency of management.

The cost system that doesn't tie up with production standards; that doesn't show how closely you have come to realizing the best way of doing anything; in other words, that doesn't give values as well as costs, is a misnomer, and one that is destined to breed narrow, cribbed and inefficient management. Therefore, and cost system should be, as Mr. Emerson points out, so arranged that it gives:

To the comptroller—information that will show him where the money goes.

To the efficiency engineer—information to show him whether standards are being realized.

To the manager—information to show him where his losses are occurring and his highest efficiencies are being realized.

In order to do this Mr. Emerson continues:

The requisition system must be increased. You apply requisitions to materials—why shouldn't you apply them to personal services and other charges?

This brings us to the newest type of management, which has always existed wholly or in part, but has only recently been given a new name, because it has only recently been recognized as a type.

The largest flag pole in the world has been raised on the grounds of the Panama-Pacific International Exposition on the site of the Oregon state building. The pole was shaped from a single fir tree given by the citizens of Astoria, Oregon. It is 230 ft. long and 6 ft. across the butt end. A flag 46 ft. long was raised on it on June 6, 1914.

LIGHTING METHODS

QUARTZ LAMP CHARACTERISTICS AND COMMERCIAL USES.

(This article describes the use of the Quartz lamp and its operating characteristics. The fields, other than for lighting, in which it has found application are also mentioned as indicating new uses for central station service.—The Editors.)

With the advent of the gas-filled incandescent lamp and the recent improvements in the flame carbon lamp it is interesting to note some of the characteristics of the quartz lamp which is also coming to occupy an important place in the field of artificial illuminants.

The construction details were described and illustrated in the Journal of Electricity, Power & Gas, February 1, 1913, and installation data in the issue of March 14, 1914. It is therefore believed that the readers of the Journal will be interested in some of its operating characteristics and commercial uses.

In the well known Cooper-Hewitt glass tube mercury vapor lamp, the light is produced by a luminescence of the vapor and is strictly a line spectrum, while in the quartz burner, a band spectrum is obtained by the heating of the vapor to incandescence.

The result of this is that a certain amount of red is introduced, but not enough to eliminate entirely the characteristic green color of the mercury vapor lamp.

The color of this light, according to measurements made by Dr. Herbert P. Ives, with his colorimeter, is exceedingly close in integral color to average daylight.

On account of its extremely high efficiency the quartz lamp has found wide application in the lighting field though the color of the light has limited the application more or less to industrial work.

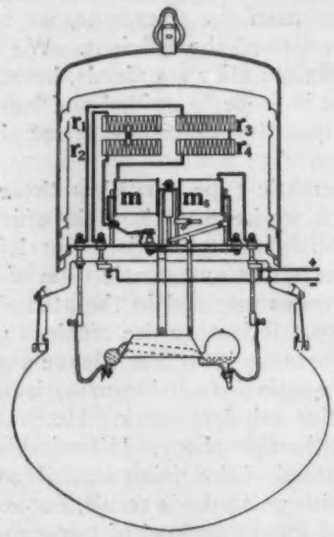
Due to the large flux obtained, it is possible to mount the 220 volt lamp in shops up over cranes at a height approaching 100 ft. and yet obtain excellent illumination on the floor. Owing to the absence of any necessary trimming, the lamps can be mounted in inaccessible places without building special platforms or runways for the attendant. The burners when properly adjusted permit of a reasonably wide variation in line voltage enabling the lamps to be operated on ordinary power circuits with no difficulty whatsoever. Among the more successful fields of application of the quartz lamp so far developed might be mentioned; engine rooms, smelting works, armories, automobile, shipbuilding, locomotive and plate glass plants. In fact the lamp is adapted for any industrial application where the necessary height for good distribution can be secured.

Yard lighting is another field in which the quartz lamp has proved satisfactory, the best results being obtained by placing the lamps on poles at a height ranging from 40 to 70 ft. above ground.

A number of small installations of street lighting have been made in co-operation with business men's associations, but the number has been restricted owing to the lamp not being adaptable for alternating current or on series circuits. However, with the advent of a lamp so adapted, there is no doubt that it will become popular for this purpose. Lamps hung 40 ft. above the sidewalk give fairly even illumination over streets from 60 to 80 ft. wide.

The color of the light afforded is often appreciated by the merchant for the contrast afforded between it and the window illumination which brings out the latter more prominently.

An interesting example of lighting by the quartz lamp is that of lighthouses for the U. S. Government. The Light House Board has proved that this



Section Through Commercial Type of Quartz Lamp.

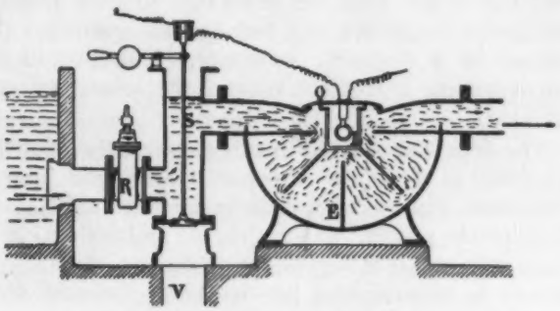
lamp is excellent for ordinary light house lenses. Its color also affords light entirely distinctive and prevents the confusion of the lighthouse light with a fixed white light ashore. Quartz lamps are now being used to illuminate the memorial tower of the Seamen's Institute near Brooklyn Bridge, New York City, and the light, which is the only green one on the coast, has been designated and charted as an official light by the light house department.

Naturally, with the high efficiency lamp the question of maintenance is an exceedingly important one. In the case of the quartz lamp the replacement of the burner is practically the one item entering into this account, and when a burner is broken or loses its vacuum it is not necessary to purchase a new one as this one can be refilled, and there is always some scrap value for the old burner. As far as can be ascertained from the figures available at the present time, the cost per 1000 hours burning will average somewhere between $4 to $5.50 for the 220 volt lamp.

A study of the spectrum reveals a presence of ultra-violet rays, though in the commercial lamp these are absorbed by the enclosing glass globe. These rays are chemically active and are capable of utilization in commercial applications, such as photography, industrial chemistry, pathology and sterilization, some of which are described herewith.

Extensive experiments made on the bacterial effect of the Quartz tube light on microbes reveal the following facts. That for short distances, the 220 volt lamp is five times as active as the 110 volt lamp and for greater distances (24 in.) it is ten times as great; the action is independent of temperature, and the absence of oxygen does not decrease the speed with which it takes place.

The action may be retarded from a period of a few seconds to one of from 3 to 5 hr. by interposing



Section Through Quartz Lamp Sterilizer.

a sheet of clear glass a fraction of an inch thick. Sheets of mica also have a retarding effect.

These facts lead to the conclusion that there is a wide field opened for the lamp in the sterilization of milk and water and such is the case, a number of plants for this purpose having been established in small towns in France and Italy where the water supply is being completely sterilized by the use of the quartz lamp. No plants on a large scale for this purpose have been erected in this country, as yet.

The apparatus used for this purpose possesses some features which are unique and which will doubtless prove of interest to Journal readers.

It consists, as shown in the accompanying illustrations, of a cast iron container, having mounted therein a quartz lamp in a box with windows of quartz on three sides. The water flows in towards the light and by means of baffle plates is made to come in contact with the ultra violet rays three times. To prevent any water from flowing through the sterilizer when the lamp is not operating, a magnet is placed in series with the lamp which opens a drain valve when the lamp ceases to operate and allows the water to pass out through another opening. A filtration plant is generally operated in connection with the sterilizer as the water must be free from dirt. The outfit described herewith is capable of perfectly sterilizing 130,000 gal. of water per 24 hr. day at an energy consumption of 725 watts.

While the sterilization of water may be efficiently carried out as explained, the commercial sterilization of milk is not such an easy matter, owing to the fact that milk in bulk is impervious to the ultra violet rays. This obstacle which has therefore prevented the commercial adoption of this idea, can be overcome by running the milk in thin streams over drums or plates and allowing the rays of light to impinge thereon.

Equally interesting are a number of other uses of the light from the quartz lamp which are now being developed commercially. Perhaps the one that appeals to the greatest number of people is that of photography. For this class of work it can be substituted for the different types of arc lamps at present in use consuming from 20 to 30 amp. with their attendant higher costs of maintenance and operation.

An outfit has been especially designed for use in connection with either the ordinary skylight or a mercury tube light for high class portraiture and window picture work. It is also used in obtaining Rembrandt effects. The burner in this outfit is equipped with a parabolic reflector enclosed in a metal box with diffusing glass and the lamp can be adjusted for any height and any direction, so as to give spot light effects.

The lamps are also used in moving picture studios, and blue printing machines, a special lamp being developed for the latter.

Flour may also be bleached by the rays from the quartz lamp, in which case, however, the ionized air generated by the lamp must be prevented from coming into contact with the flour because of the deleterious effect it would have on its food value. This is accomplished by enclosing the lamp in a quartz box.

Still another industrial process is the "debloom-ing" of hydro-carbonate and vegetable oils and paraffine. The old method was to expose the oil in shallow uncovered tanks to the sun rays for a number of weeks. By exposure to the rays of the quartz lamps, the same results may be obtained in much less time.

The fixation of patent leather according to the established method is accomplished by varnishing and baking the leather and then exposing it to the sun for a period of at least ten hours. By substituting the quartz lamp for the sunlight this period may be reduced to three hours and the operation then performed under atmospheric conditions most conducive for effective work.

Finally, among the applications to be mentioned, and of very general interest to the public at large, is the use of the ultra-violet rays to replace sunlight in testing the permanency of colors in different fabrics. Formerly, this required the exposure of the sample to sunlight for periods aggregating 72 hr. on clear days, whereas with the quartz lamp the same results can be obtained in a very few hours.

From the results already obtained in the application of the quartz lamp to various industries, some of which have been mentioned, it is safe to predict that the lamp, in addition to its own particular field of lighting, is destined to play an important part in the field of industrial development.

Prospecting for oil in Alberta has resulted in the discovery of a fine quality of oil at a depth of 2700 feet, in what is called the Dingman well, near the city of Calgary. The oil is of such a high grade that it can be used successfully in automobiles after having passed through the filter. Gravity tests of the oil are said to show 64 degrees Baume. It is stated that 900 gallons were taken from the well in 6 hours. Six other companies are prospecting, and numerous companies have been organized since the discovery of the flow in the Dingman well. Drilling outfits are being ordered by wire and operations will be carried on extensively.

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POWER AND GAS

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CONTENTS

The Multiple Arch Dam of Reinforced Concrete.....521
By C. E. Grunsky.
Underground Hoisting and Compressor Station.....537
Factory Safety Suggestions.....537
Requirements for Success in Selling.....539
By R. I. Carruthers.
Electric Smelting.....539
The Three Types of Management.....540
By E. St. Elmo Lewis.
The Largest Flagpole.....541
Quartz Lamp Characteristics and Commercial Uses.....542
Prospecting for Oil in Alberta.....543
Editorial.....544
Personals.....546
Meeting Notices.....547
California Association of Electrical Contractors.....547
Publications Received.....547
Oregon Electrical Contractors' Association.....548
New Catalogues.....548
California Association of Electrical Inspectors.....549
Oregon Railroad Commission.....549
News of the California Railroad Commission.....549
Trade Notes.....550
Steam Pipe Bends.....550
Book Reviews.....550
News Notes.....551
Brains as an Ingredient.
Keep Informed.
Free Phones and Fares.

Brains as an Ingredient

Those innovations which represent the most radical departure from accepted practice usually meet the greatest opposition. The reason may be that it is difficult to spill from the mind that which is already known to be of comparatively successful application. Yet this spilling process is essential, in order that the advantages resulting from progressive practices may be fully enjoyed.

It seems anomalous to speak of brains as an ingredient, but when used, it generally follows that the more gross materials are reduced in quantity, thus resulting in a desirable economy. The use of this most expensive ingredient insures the lowest effective cost.

The article appearing in this issue on the Multiple-Arch-Dam is therefore of especial economic interest. It discusses a subject of vital importance to the wide hydroelectric power, water supply, and irrigation interests of this last West, emphasizing as it does, an economy of construction due to the application of engineering skill.

Reduction of cost in dam construction has often been deplored as contributing to a lower factor of safety, but the construction discussed permits a dam of extremely low cost, yet having a greater than usual factor of safety combined with permanence.

Cheaper structures are not necessarily caused through the financial limitation of the builders, nor upon a sacrifice of safety.

Multiple arched dams also make possible an economy of time in construction, as only one-third or less than the material usually required has to be placed.

Economy is seen to consist in the elimination of excess without impairment and preferably with improvement.

The principle of construction discussed is not new measured from the time of its first use, though in more crude form, but is certainly so with regard to its more advanced design and possibilities of more general adoption. This may be temporarily retarded due to that type of commission control which places a premium upon the amount expended rather than upon the skill displayed in construction of the works upon which it is expended.

The Meer Allum Dam, embodying the fundamental principles of this design, was erected in India, as far back as 1800. It is about one-half mile in length, and consists of 21 arches, with spans varying from 70 to 147 ft.

Yet notwithstanding its early adoption, there has existed until quite recently a dearth both of publicity and information regarding this desirable type of construction. Even in some of the latest works on the subject, the ideal conditions in connection with the choice of a dam site do not appear to consider the possibilities and the advantages of this type, though it is almost invariably referred to, in a brief paragraph, as being a very desirable method of construction. Some even go as far as to exclude design as a fundamental constructional consideration, though mentioning quantity of material in this connection.

Dams depending upon mass for their stability do not, however, differ widely from those built by the

pioneer Beavers from whom man perhaps first conceived this idea of hindering the stream flow and of holding it to controlled and more complete uses of increased value.

But the economy and safety effected by design, and its ability to successfully withstand the incident stresses are of more importance than the availability or character of the material entering into its construction. The weight of skill tips the beam in its favor and brain as an ingredient is found to be heavier than matter.

This is interestingly indicated in the captions illustrating the article referred to, where it is shown that a multiple arched dam depending for its stability upon scientific design, although having a safety factor two times as great and giving three times the storage capacity, was built at the same cost as the old dam first constructed, which depended upon weight of material for its stability.

With the multiple arched dam there is also an admitted freedom from upkeep, and in that it is comparatively water tight there exists also an economy of conservation.

By the use of apparatus of scientific design, together with the application of a few simple rules, it is sometimes possible for the novice to readily solve problems previously difficult of solution. In this connection it appears unnecessary to point out that the article in this issue does not profess to teach the tyro how to successfully build a multiple arched dam. Dam sites vary so widely that it rarely occurs that one design is suitable for two of them, and the services of a competent and qualified engineer will always be necessary for the successful completion of any such project.

Some of the questions which the author propounds are answered in a practical manner by the successful erection and performance of dams of this type erected in the West, such as that illustrated, the Hume Lake Dam, described in this Journal for October 30, 1909, the Los Verjels Dam, and others, while the technical question propounded by the author is ably treated in the article.

Keep Informed

On account of the greater areas, rural as well as urban, now covered by central stations, together with invention and a cheapening of product, there has been opened up a field so vast that the special training of salesmen is now essential if satisfaction is to result.

In selling electric service the salesman must realize that the service is not complete until he has done his part.

There is a definite connection between satisfied customers and sales which stay put. The connecting links are trained salesmen having active interest in their customers' affairs.

A trained salesman of electric service is one having a complete understanding of the science of salesmanship, together with knowledge of his commodity, of his customers' requirements and the manner in which these may be filled.

The value of each salesman is in direct proportion to his ability to serve. This in turn depends to a large extent upon his fund of specialized knowledge.

The reason why some men do not accomplish more or gain advancement, is that they do not know enough and are satisfied instead with their ability to temporarily hoodwink their employers as they short-weight the "service" doled out to customers.

Keep informed.

Free Phones and Fares

There exists in many municipalities a condition which would not be tolerated by any public service commission having that broad outlook essential in such bodies, in order that the interests of all the people be adequately protected.

This condition results from political control of public utilities by the municipalities, and is consequently unfair.

The desire for something for nothing, or a mistaken sense of economy, has caused many municipalities to insist upon free telephone service for civic buildings, and of street car passes for city employes.

In the days when sops of this nature were necessary for the betrayal of the public, success along these lines might have been considered good practice, but there is now a growing appreciation of the necessity for the conduct of all business upon strictly business lines.

There is also the realization that the use of public utilities which name conveys the impression of general use by all the public, is really restricted and variable.

The necessary use of the telephone for the transaction of civic business requires the incurrence of legitimate expenditure, as also does the use of street cars by city employes while engaged in their official duties.

Street car fares and telephone tolls are a tax upon their respective passengers and subscribers. It cannot be disputed that both free fares and phones find their way into the taxes paid by those using these utilities, while the non-user—and their name is legion notwithstanding the premier position of Pacific Coast cities in the development of telephone service and the creation of traffic records—have their direct taxes reduced by this amount.

Such a condition is certainly unsatisfactory and unjust, for apart from the generally wasteful use of that which "costs nothing," it is admittedly unfair to saddle utility users with the additional expense of conducting these necessary branches of public service, which for the proper distribution of this tax burden should be paid by all.

It is stated that in San Francisco, the item of free civic telephone service alone necessitates the investment of one million dollars

The existence of such an undesirable condition of affairs at this stage of commission control is but a further indication of the need for all utilities if they must be controlled, to come under the control of but one public service commission.

Probably the jurisdiction of the federal commissions may be extended, and ultimately become the logical court of appeal. This is a question calling for early consideration by those in favor either of state or federal control. But in the interim the need is seen to exist now for that wider and more uniform interpretation of the law, and that rendering of justice which would naturally result from the unvarying control of all public utilities by the state.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

L. G. Harkness Smith of the educational department, So- presentation of some interesting features here at that time.

A. Terkel, president of the Reedley Telephone Company, Reedley, Cal., was a visitor at San Francisco during the week.

George Cook of the American Cross Arm Company was in Seattle last week.

L. A. S. Wood, arc lamp specialist with the Westinghouse Electric & Manufacturing Company, is at San Francisco.

Chas. W. Baker, district engineer with Westinghouse Machine Company, Hunt, Mirk & Company, Pacific Coast agents, is at Visalia, Cal.

E. M. Cutting, of the Edison Storage Battery Supply Company, San Francisco, is making a business trip through the Pacific Northwest.

Frank Fowden of the Brooks Follis Electrical Corporation, San Francisco, is making a business trip through the Sacramento valley.

E. B. Walthall, assistant general manager, San Joaquin Light & Power Company, was at San Francisco from Fresno during the past week.

W. L. Overman, representing the Hughes Electric Heating Company, has located in Seattle. Mr. Overman recently spent a week in Portland.

K. G. Dunn, vice-president, Hunt, Mirk & Company, San Francisco, is on a business trip to Alaska and will also visit cities in the Pacific Northwest.

H. C. Goldrick, Pacific Coast manager Kellogg Switchboard & Supply Company, has returned to San Francisco from a short trip to Oregon and Washington.

H. D. Brainard, sales manager of the Western Electric Company at Seattle, recently returned to Seattle from Portland, where he spent a week with the Portland branch.

Hal Lauritzen of the Holophane Works of General Electric Company, is at Los Angeles on special business and will return to San Francisco during the early part of next week.

V. R. Lansingh, manager glass and steel reflector department National Quality Division of General Electric Company, has returned to Nela Park from a six weeks' trip to Europe.

J. B. Rowray, superintendent Northern Electric Railroad, will continue to conduct the business of his department from Chico, Cal., as it has now been decided not to remove his office to Sacramento as previously intended.

N. C. Kingsbury of New York city, vice-president of the American Telephone & Telegraph Company, the parent company of the Bell interests, arrived at San Francisco last week and is now at Los Angeles.

John B. Fisken, superintendent light and power department Washington Water Power Company who is chairman of the Spokane Section A. I. E. E., will attend the annual convention of the Institute at Detroit, Mich.

E. S. Berdine, Pacific Coast representative of the Gleason Tiebout Glass Manufacturing Company, has just returned to San Francisco from Los Angeles and reports having secured a stock order from the Mayberg Company, whose premises were recently partly destroyed by fire.

Leonard Lundgren, Assoc. M. Am. Soc. C. E., District Engineer United States Forest Service, has been transferred from Denver, Colorado, to Portland, Oregon. The territory embraced in the Portland district includes the National Forests in Oregon, Washington and Alaska.

Bertram Smith, assistant manager of the Pacific Coast Division of the Edison Storage Battery Company, returned to Salt Lake City from Butte, where he had gone in connection with some orders for electric truck sprinklers and fire equipment now under consideration by the Butte city council.

E. H. Richardson, secretary of the Hotpoint Heating Company, at Ontario, Cal., has announced that his company has made arrangements to give employment to the entire graduating class of the California George Junior Republic, in Southern California. There are twelve in the class, which will graduate this month.

F. V. Cook, representative of the Ohio Brass Company in the Intermountain territory, with headquarters at Salt Lake City, has recovered from his injuries sustained in an automobile accident in Ogden Canyon. **O. W. Hershey**, special representative of the Westinghouse Lamp Company, is still confined by his injuries at the hospital in Ogden.

Bion J. Arnold, Chicago traffic expert, with his staff of assistants, commenced last week an inspection and appraisal of the property of the Oakland, Antioch & Eastern Railroad as the representative of eastern and western stock holders. Mr. Arnold is stated to have said that, so far as his investigation has gone, he has found the railroad a valuable property.

W. A. McGovern has been appointed general manager of the Northern Electric Railway Company and took charge of his new office on June 15th. Mr. McGovern has been assistant division superintendent at Pocatello, Idaho., on the Oregon Short Line. For many years previous he was connected with the Southern Pacific as division superintendent at Oakland.

J. M. Barry, who has been elected head of the department of electricity to the position formerly held by **William J. Nixon**, arrived in San Francisco from Portland and assumed the work of his new office. By the action of the board of supervisors in relaxing the residential qualification in his favor, it made his election possible, and at a joint session of the fire and police commissions he was duly elected to the position.

L. G. Harkness Smith of the educational department, Society for Electrical Development Inc., New York, who has been at San Francisco for the past week, left for the south on Friday, but expects to return about the middle of July. The Journal is giving due notice so that all electrical men whether members of the Society or not, will plan to enjoy Mr. Smith's presentation of some interesting feature here at that time.

R. W. Tavey, engineer from the National Lamp Works of the General Electric Company is in Salt Lake City. Mr. Tavey is making a tour of the western states visiting all of the Western Electric Company offices in that territory with special reference to the introduction of the "Type C" Mazda lamp. He reports that it is taxing the capacity of the factories to supply the demand for this unit which is meeting with especial favor for exterior lighting purposes.

M. F. Lewis, factory representative of the Olston Electric Stove Company of Los Angeles, gave a box party at the Empress theatre, Thursday, June 11th. Robert Hall, the clever impromptu song monologist, was on the bill and being a personal friend of Mr. Lewis, had considerable fun at the expense of the twenty odd electrical guests. Incidentally, the "Do it electrically" slogan received considerable publicity in Mr. Hall's impromptu jingles, and made quite a hit with the regular Empress patrons. After the show the party adjourned to Maxim's.

J. Harry Pieper, of the Southern California Edison company, who arranged the program, presided as chairman at the Los Angeles Ad. Club luncheon last week. The principal speaker was **B. F. Pearson**, general superintendent of the Southern California Edison Company, who outlined the different features of developing electric energy and told how it is carried to Los Angeles, over high power transmission wires. **J. A. Quinn**, proprietor of the Garrick and Superba theatres, then told the ad men some of the advantages and benefits of electrical advertising. **Andrew M. Strong** of the Greenwood Advertising Company, described the construction of an electric display sign.

MEETING NOTICES.

Illuminating Engineering Society.

The report of the committee of tellers of the Illuminating Engineering Society on the results of the recent annual election, presented to the Council of the society June 11, showed that the following national officers had been elected for the ensuing year: President, Dr. A. S. McAllister; Vice-Presidents for two years, F. A. Vaughn and C. A. B. Halvorson Jr.; General Secretary, Joseph D. Israel; Treasurer, L. B. Marks; Directors for three years, Ellice M. Alger, Harold Calvert, V. R. Lansingh.

San Francisco Electrical Development and Jovian League.

The league met as usual at the Hof Brau Cafe and after luncheon listened with great interest to a talk given by L. G. Harkness Smith of New York, who has charge of the motion picture department of the Society for Electrical Development, Inc., on the work now being done by that organization. Short speeches were delivered by C. C. Hillis, R. M. Alvord, W. L. Goodwin and others. The chairman of the day was C. W. Wiggin. The meetings were adjourned for the summer months, the next meeting being called for the first Tuesday in September.

Jovian Electrical League of Southern California.

In spite of the warm weather, the attendance at the luncheons keeps up remarkably well, 125 members being present on June 10th, to enjoy the varied and interesting program provided by R. J. McHugh, chairman of the day. The musical treat consisted of songs by the charming entertainers, the Misses Dempster and Hogan. A subscription was taken up for the expense fund for the annual picnic to be held on June 20th and over $200 was subscribed in a few minutes. Two Jovian rings, presented to the league by the recent prize winners, Messrs. Drake and MacDonald, were raffled off and won by Messrs. McCutcheon and Colkitt, and the sum realized was added to the above fund. A few interesting remarks were made by Jovian Hardman of San Diego and Judge White, who appeared to have a "fine" acquaintanceship among the Jovians. A very interesting talk was then delivered by Louis G. Guernsey, political editor of the Los Angeles Times, his text being "Personal Aspects of National Characters." It was decided by the League to have no luncheons between July 1st and September 15th.

Utah Society of Engineers.

Dr. F. G. Cottrell of the United States Bureau of Mines delivered a talk before the Utah Society of Engineers at the Consolidated Music Hall on Wednesday evening, June 10th on his electrical system of smoke deposition. His talk was an especially timely one in view of the strong agitation which has developed in Salt Lake City during the past three or four years looking to some solution of the smoke nuisance, which has become so serious with the rapid growth of the industrial plants in this city.

Dr. Cottrell pointed out that it was known as early as 1824 that finely divided solid particles carried in suspension in the air could be deposited on a plate by means of a brush discharge from a static machine in the field. No practical progress was made however, owing to the fact that the static machines available at that time were entirely inadequate in commercial application. Again in 1850 in an article in the Mechanics' Magazine of London the same phenomena was reported and attention was called to the fact that this could be used for the purpose of throwing down finely divided particles carried in suspension in the air. Sir Oliver Lodge in 1884, without a knowledge of the work of previous discoverers, reported before a meeting of the British Society of the Chemical industry his discovery of this fact, and patents on the general principle were taken out at that time in Great Britain and several other countries. These patents have long since expired.

In 1905-6, Prof. Cottrell, then connected with the University of California, took up the work. The big advance which he made in the process consisted in the abandonment of the static machine as a source of high potential direct current. He arranged to tap off the peak of the voltage wave from a high potential alternating current circuit, thus securing a high potential uni-directional source of energy. This permitted the practical application of the process to sulphuric acid plants, powder works, cement plants, and smelters.

At Riverside, Cal., ninety tons of cement dust per day are recovered from the flues of the Riverside-Portland Cement Works plant by this process with an expenditure of only thirty-five kilowatts of energy. It is reported that the waste product recovered practically pays for the expenses of operating the system.

Dr. Cottrell frankly states, however, that he does not see how this process can be successfully applied to the solution of the smoke problem in Salt Lake City except in special cases. He believes, however, that the solution lies more in the direction of securing a smokeless fuel and urged that the city take steps to have a careful economical survey made to determine whether or not the problem may be solved in this way.

CALIFORNIA ASSOCIATION OF ELECTRICAL CONTRACTORS.

The fifth annual convention of the Association will be held at Sacramento, Cal., on August 5, 6, 7 and 8, 1914, the Hotel Sacramento having been selected as the convention headquarters. The secretary has made the following announcement to the electrical fraternity of California: "Co-operation means to get together for the promotion of a common interest. You are invited to co-operate with the electrical contractors at this convention.

"In addition to the regular business of the convention, there will be two open meetings, at which papers of interest to the entire fraternity will be presented. The committee has also arranged a splendid entertainment program, so that ladies and guests will not have a dull moment.

"Take your family with you and make this your annual vacation."

The preliminary program is as follows:

Tuesday, 9:00 a. m.—Executive Committee meeting.
Tuesday, 2:00 p. m.—Executive Committee meeting.
Wednesday, 9:00 a.m. to 12 m.—Meeting for members.
Wednesday, 2:00 p. m. to 6:00 p. m.—Meeting for members.
Wednesday, 1:30 p. m.—Ladies and visitors boat trip down Sacramento River. Refreshments on board.
Wednesday, 8:00 p. m.—Reception and dance, banquet room, Hotel Sacramento.
Thursday, 9:00 a. m. to 12:30 p. m.—Meeting, members only.
Thursday, 2:00 p. m.—Every one take auto trip to Folsom.
Thursday, 8:00 p. m. to 12:30 a. m.—Moonlight boat ride. Dancing on boat.
Friday, 10:00 a. m.—Open meeting.
Friday, 1:30 p. m.—Sightseeing auto trip.
Friday, 2:00 p. m.—Open meeting.
Friday evening—Annual dinner and ball.
Saturday—Annual outing trip on river. Dancing on barge. Games and lunch on shore.
Saturday, 8:00 p. m.—Jovian Rejuvenation

PUBLICATIONS RECEIVED.

Power Plants for Textile Mills are fully described in Number 7 of the Textile Quarterly issued by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

A booklet containing complete information regarding membership and organization of the Electric Power Club, which has for one of its objects the standardization of electrical machinery, is to hand. It is also a report of the work thus far accomplished by the club and by its predecessor, the American Association of Electric Motor Manufacturers. The booklet is offered in the hope that further standardization will be encouraged and in full belief that the practices suggested are fundamentally correct and will be valuable in guiding the development of electrical apparatus.

ELECTRICAL CONTRACTORS' DEPARTMENT

A Real Convention Crowd, Oregon Electrical Contractors' Association.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION.

The second annual convention of the Oregon Electrical Contractors' Association was called to order at 9:30 a. m., on June 8th, by J. E. Werlein of the Portland Railway, Light & Power Company. Mayor Albee of Portland was introduced and made a few remarks in behalf of the city of Portland. In brief he stated that the city was taking note of the work of the organization and that he wished to extend the hand of fellowship and to impress upon their minds the fact that the city's welcome was hearty and sincere. Mayor Albee was made an honorary member of the association.

R. G. Littler, president of the Oregon Electrical Contractors' Association, responded to Mayor Albee's remarks. Mr. Littler stated that the Oregon Electrical Contractors' Association now had forty members and that the association had lost two members during the past year through the death of Geo. Ormsby and Charles Potter. "This convention is being held for both business and pleasure," said Mr. Littler, "and the organization hopes soon to have all the best contractors in Oregon as members of the association. Great importance must be given to the campaign this fall for a state license law. Tendency of a good and sufficient state license law to eliminate the curbstone contractors which has been borne out by the experience of Memphis, Tennessee. An effort was made last legislature to have a state license law enacted in Oregon, but due to the confusion of understanding regarding its purpose and issues at stake the bill was defeated."

The slogan of the convention was "Do It Elctrically," and this fact was impressed upon the members by Mr. Werlein, after which he handed the gavel to President R. G. Littler, expressing the wish that the third annual convention would be even more enjoyable. Geo. L. Baker, manager of the Rose Carnival Committee, stated that electricity played a big part in making the carnival a success. A letter was read by the president from G. W. Hill, special representative of the N. E. C. A. This letter was full of witty stories and emphasized the fact that there was always strength in organization. Ernest Freeman, president of the N. E. C. A., had been invited to attend the convention, but was unable and sent a letter expressing regrets.

Ross Hartley presented a paper entitled "The Electrical Jobbrs." Mr. Hartley is manager of the Pacific States Electric Company at Portland, Ore. Mr. Hartley's paper was quite original and emphasized the general movement all over this country for the inauguration of better business. The next paper read was from J. M. Wakeman, manager of the Society for Electrical Development, the title of his paper being the society of which he is manager, the paper being read by J. R. Tomlinson, who was followed by Mr. Underwood, treasurer of Failing, McCalman Co., who read a paper on "Fire Causes and Prevention."

At the 1:30 p. m. business meeting many matters of interest to members were brought up and discussed. The proposed state license law, which will be introduced at the next meeting of the Oregon Legislature, called forth a great amount of discussion. The association has a committee working upon a re-draft, which will soon be perfected. On the completion the proposed law will then be submitted to the different organizations throughout the state for their approval and support. The proposition of amalgamating the State Association and the Portland Electrical Contractors' Association, was also brought up and referred to a committee to report on same. The association elected J. R. Tomlinson to be the next director, representing the state of Oregon in the national convention. Also to go to Detroit to attend the national convention in July. It was voted to request the N. E. L. A. to send their special representative, Geo. W. Hill, to this coast as his assistance is needed in increasing membership and reviving the association spirit on the coast.

The entertainment part of the program was carried out as previously reported.

In the evening the delegates and guests, numbering 200, assembled in the main dining room of the Portland Hotel for the annual banquet. J. E. Werlein, presided as toastmaster and the speaker of the evening was Franklin T. Griffith, president of the P. R., L. & P. Co. In addition to the talk of the evening several entertainment features were provided.

NEW CATALOGUES.

Sprague Electric Hoists are described pictorially and with a very clear text in Bulletin 905 just issued by the Sprague Electric Works of General Electric Company.

"Westinghouse Railway Data Exchange" No. 8, just issued by the Westinghouse Electric & Manufacturing Company, deals with the efficient use of cars, giving considerable data as to the relative cost of operation of different systems.

"Westinghouse Wicker Type Electric Linotype Pots" is the title of a somewhat elaborate publication (No. 1531) just issued by the Westinghouse Electric & Manufacturing Company, on this subject. The linotype pot is thoroughly described and illustrated and its advantages are explained in detail.

The Electric Storage Battery Company has recently published a new bulletin on "The Ironclad-Exide Battery for Storage Battery Locomotives." In addition to giving a clear description of the apparatus, it contains valuable information to engineers who are interested in the subject of storage battery locomotives.

"Drawing the Crowd and Keeping It" is the title of a folder (No. 4277) just issued by the Westinghouse Electric & Manufacturing Company, with an attractive cover showing a large crowd being attracted to a 5 cent moving picture theatre. The folder deals with arc lamps for illumination and projection purposes, rectifiers, ozonizers and radiators, all of which are used in these theatres.

CALIFORNIA ASSOCIATION OF ELECTRICAL INSPECTORS

Section of N. A. E. I.

C. W. Mitchell, President. Arthur Kempston.
Wm. G. Pennycook, Vice-Pres. B. C. Hill, Executive Comm.
John W. Carrell Secretary-Treasurer, 55 Fulton, San Francisco.

The purpose of this organization is to standardize the common practice in electrical construction with the National Code as the general standard.

Questions pertaining to electrical construction will be answered in these columns, but only from the point of view of the Code. This is a voluntary organization and the answers published under this heading must not be construed as authoritative, or binding. No attempt will be made to correllate the answer from the several Inspection Districts, as an occasional difference of opinion will tend to induce further study on subjects. All questions will be passed upon by an executive committee.

Address all communications to the secretary.

SPECIAL INSTALLATION RULES.

The National Code is the correlated result of many mature minds working from diverse viewpoints but to a common end, guided by a large body of men who are responsible for the financial result of its application in the field. A document which sets forth purposes to be accomplished in a large and varied field of construction for a nation—almost for a continent—is remarkable. The Code does more than this: It points out methods by which its purposes should be accomplished in detail for the more simple or well-established methods, but mostly in mere outline, leaving the minor details to the good judgment of the mechanic, the inspector or the engineer. If in the handling of the details the personal equation did not enter and if all concerned clearly understood the purpose of the Code, if the rules could be always interpreted alike, and minimum requirements were not usually considered maximum requirements, perhaps no confusion could occur; but experience has proven that confusion does occur and that it exists where fire and life hazards are dealt with and where many men secure their livelihood may be regarded at least as something more than a tempest in a teapot. Special rules are needed, but not many rules; a few well studied and well arranged.

There are some very reasonable objections to special rules. Could some modern disinterested Diogonese be induced to turn his flashlight on the inspection service in two cities, one where complete order maintained and one where confusion prevailed, a principal reason for the results in both cases would be, "Special Rules."

To weave a tangled web of words to cover a special idea or case and to put these forth as a general mandate for all cases has been the well-intentioned result of some inspection bureaus. Again the sources of interpretation in adjoining districts vary and the interpretations or special rules, however clearly set forth, differ widely. Special rules should be arranged with great precision and clearness, with proper correlation with existing rules and after conference with able men having special knowledge of the subjects treated, or not at all.

The C. A. E. I. holds a meeting at San Jose this afternoon, June 20th, in the Chamber of Commerce. An effort will be made to start a schedule of common practice based entirely on the Code and calling into play all the special knowledge possible on the subjects treated. All members of the association, as well as all other men engaged in electrical inspection service, should make an effort to attend this meeting.

OREGON RAILROAD COMMISSION

General regulations governing overhead and underground power lines within Oregon, have been issued by the commission. These regulations were originally issued August 29, 1913 and became effective October 1, 1913. The present construction of telegraph, telephone, signal, trolley and regulations are as amended April 23, 1914, and made effective May 12, 1914.

NEWS OF THE CALIFORNIA RAILROAD COMMISSION.

The Railroad Commission has rendered a decision in which it authorizes the San Joaquin Light and Power Corporation to issue 5 per cent bonds in the sum of $3051.00 and the San Joaquin Light and Power Company to issue 5 per cent bonds in the sum of $129,000. The bonds to be issued are to be used for the purpose of retiring outstanding underlying bonds.

The commission has issued an order calling inquiry into the rates, charges, rules, regulations, practices and service of the Western States Gas & Electric Company in the sale of electricity in Sacramento, San Joaquin, Eldorado, Amador and Calaveras counties.

The commission has rendered a decision granting authority to the Southern Counties Gas Company, operating in Orange county, to cancel an escrow agreement covering the unissued portion of its preferred stock. The company had placed $150,000 of its stock in escrow and the commission's order will enable it to return this stock to its treasury.

The commission has rendered a decision granting authority to the Western States Gas & Electric Company to issue two promissory notes, one for the sum of $108,900 and the other for $232,100.

The Southern California Edison Company applied to the commission for authority to use $30,000 of bonds for the purpose of purchasing the Downey Light, Power & Water Company.

The Southwestern Home Telephone Company has filed a supplemental application with the commission asking authority to reissue three notes of a total sum of $8500.

The commission has rendered a decision granting authority to the Fresno Interurban Railway Company to issue $120,000 in bonds and $60,000 in stock for the purpose of building a standard gauge electric railroad from Fresno to Clovis, a distance of 9 miles. The line will connect with the Fresno Traction Company.

The commission has rendered a decision authorizing the Northern Electric Railway Company to operate under lease the property of the Sacramento & Woodland Railroad Company. The lease is subject to revision or alteration by the commission, or other competent public authority, at any time, in any rate fixing inquiry or otherwise.

The Southern California Edison Company has filed an application with the commission for an order authorizing it to sell its electric distributing system at San Fernando, Los Angeles county, to the Pacific Light & Power Company.

The Southern California Edison Company has filed an application with the commission, in which it asks permission to purchase 1060 shares of the preferred stock of the Long Beach Consolidated Gas Company at 80. This is part of the 1400 shares, the sale of which had been previously authorized by the commission.

The commission has rendered a decision granting authority to the Southern California Edison Company to use a portion of the 5 per cent bonds heretofore authorized for the purpose of purchasing the Downey Light, Power & Water Company of Downey, Los Angeles county. The company asks for authority to use $30,000 of bonds for this purpose.

The commission has rendered a decision granting authority to Rose L. Burcham, the owner of a telephone company operating in Randsburg and Mojave in Kern county, and Atolia in San Bernardino county, to sell the plant to the Interstate Telegraph Company for the sum of $3,000.

The Fowler Gas Company, which is engaged in the manufacture of gas in the town of Fowler, Fresno county, has been authorized by the commission to issue 6 per cent 10 year bonds of the par value of $15,000. The proceeds derived from the sale of these bonds is to be used to retire certain outstanding notes and to make certain improvements and extensions to the gas company's plant.

TRADE NOTES.

Campbell & Rust, Electrical Contractors at Seattle, have recently secured the contract for the complete electrical equipment of the Lincoln High School at Seattle, Wash.

Tacoma headquarters of the Westinghouse Electric & Manufacturing Company have moved from 1211 Fidelity building, to 924 Commerce street. H. V. Wilkinson is manager.

The J. C. English Company of Portland, Oregon, has been awarded the electric fixture contract for Mrs. H. L. Pittock's residence on Imperial Heights, Portland, Oregon. Value of contract is $7700.

The electrical installation in the new fire-proof theatre to be erected on the southeast corner of Main and First streets, Portland, Oregon, has been awarded to the NePage-McKenny & Company.

Nearly 600 Mohrlite self-contained indirect lighting units will be installed in the new Call building, San Francisco. Forty-five of these units will be used for lighting the new Sunset Cafe, San Francisco.

Buxbaum & Cooley, electrical engineers, Seattle, Washington, recently sold to John J. Sesnon of Nome, Alaska, a sixty volt d.c. single-phase 5 h.p. generator set to be used in connection with freight lighters at that point.

B. F. Kierulff Jr. & Company, electrical jobbers, recently moved from 120 South Los Angeles street to 757 South Los Angeles street, where in the new and more commodious location, they are better prepared to handle the business.

Busch, Sulzer Bros.-Diesel Engine Company, New York, have just closed an order for 6-600 h.p. Diesel engines for installation in submarines L-5, L-6, L-7, being built by the Lake Torpedo Boat Company for the U. S. Navy. Four of these engines will be used for two of the submarines being built by the Craig Shipbuilding Company of Long Beach, the third will be built at Bridgeport, Conn.

A number of the employes of the Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company went on a strike last week, because the management refused to recognize the demands of the newly formed labor union, the Allegheny Congenial Industrial Union, and as a result the works of these companies at East Pittsburg are partly shut down. The management of the company does not believe that the trouble will be of long duration.

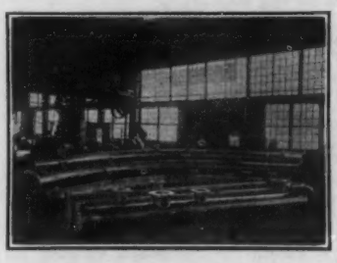
The fifth "Talking Sign" on the Pacific Coast has been erected in Portland, Oregon. The Motograph Talking Sign Company has its apparatus installed to operate the advertising portion of the sign. This feature requires the use of 1250 receptacles. The decorative feature will consist of about 1250 more receptacles forming a "rose bud" and two butterflies. A Reynolds Electric Flasher control is used. The complete sign was built for the Federal Sign System Company. The weight of the sign complete is approximately 8 tons. Its location is on the northeast corner of West Park and Washington streets.

Ground was broken for the new factory of the Holtzer-Cabot Electric Company on Amory street, Roxbury, Mass., at noon on Thursday, May 21. The ceremonies were of a private nature, and were attended by almost every employe of the company. It is expected that work will be pushed on the new factory and the company hopes to occupy its new quarters early in 1915. The building will consist of six stories with an ell of the same height, and will be of modern construction and equipment throughout. Funk and Wilcox are the architects, and Fred T. Ley Co., Inc., of Springfield and Boston are the general contractors.

Sixty distributors of the Premier Vacuum Cleaner Company from all parts of the country were guests of the big electric cleaner concern at Cleveland on June second, third and fourth. All were enthusiastic over the new plans announced which include the marketing of over 100,000 Frantz Premiers during the next twelve months. Edward L. Frantz, president, brought all present to their feet when he announced a reduction in the price from $30 to $25 and told about the $100,000 advertising campaign which starts immediately in the big magazines. The Premier Vacuum Cleaner Company started business four years ago in a single room with three employes. They now occupy a modern factory and employ three hundred men. Last year's output totaled over sixty thousand machines.

STEAM PIPE BENDS.

The H. J. Heinz Company are just completing an eight-story addition to their main factories at Pittsburgh, Pa. The first four stories are occupied by the boiler plant and the auxiliary machinery. The upper four stories contain 60 steam cooking kettles. The piping for this plant presents several novel and unique features, among which is the main steam header, consisting of 18 in. O. D. lap weld steel pipe ⅜ in. thick, totaling 162 ft. The flanges are rolled steel, attached by the Van Stone method. All inlets and outlets are forged steel nozzles welded to the 18 in. pipe. There are one 4 in., seven 6 in., one 8 in., six 10 in., one 12 in. and one 14 in. nozzles on this header. In the header are three 90 deg. bends, each bent to a 16 ft. radius and each containing approximately 40 ft. of pipe. This double length was obtained by welding together circumferentially two ordinary lengths of pipe.



Three Sections of Header and Three Bends

The connections from the triple duty valves on the boiler nozzles to the header are 10 in. in size and consist of special U-shaped bends made of a 2 ft. 7 in. radius. The accompanying cut shows three sections of the header and three bends with nozzles welded on.

The entire piping installation is being furnished by the Pittsburgh Piping and Equipment Company of Pittsburgh, Pa.

BOOK REVIEWS.

McGraw Electric Railway Manual; edited by Fred Nichols; 352 pages; 10x13. Published by McGraw Publishing Company and for sale at Technical Book Shop, Crossley Bldg., San Francisco. Price, $7.50.

The 21st annual number of the standard directory of American electric railways shows many changes which have taken place in the industry since the issue of the 1913 edition. As a manual for investors and salesmen desiring information as to the securities, earnings, officials and equipment of electric roads throughout the country it is without a peer.

Electric Light Accounts and Their Significance.—By H. M. Edwards. 172 pp.; size, 5x7½ in.; flexible leather binding. Published by McGraw-Hill Book Company, and for sale by Technical Book Shop, Rialto Bldg., San Francisco. Price $2.00.

The author, who is auditor, New York Edison Company, and member of the accounting committee National Electric Light Association, outlines in this work a system of accounts designed for electric lighting companies which he believes will prove entirely satisfactory as a means for providing those regulatory authorities having jurisdiction with all the information desired at any time, besides being of complete service to the company. The book's chief claim to the reader's interest lies, perhaps, in the explanations given of the terms used. It is in the "significance" to be attached to the matters treated that the author has endeavored to prove helpful.

NEWS NOTES

INCORPORATIONS.

SANTA ANA, CAL.—Beaver River Power & Plant Company, $100,000, by H. R. Waldo, G. F. Halliday et al.

PROVO, UTAH.—Certificate of the incorporation of the Southern Utah Power Company has been filed with the County Clerk. The company is organized under the laws of Delaware with Wilmington as the principal place of business. A. L. Woodhouse is president, H. R. Waldo, secretary and treasurer, W. L. Biersach is named as the agent of the company for Utah, and Provo named as the principal place of business in the state. The authorized capital stock of the company is 600,000 shares at the par value of $1.00 each. The company is organized for the purpose of taking over and operating the properties of L. L. Nunn in Sevier county which have been formerly operating under the name of the Beaver River Power Company.

ILLUMINATION.

AUBURN, WASH.—A franchise has been granted to J. L. Veach for the use of city streets for use of gas mains.

COVINA, CAL.—The Pacific Light & Power Company has given assurance of electric lights for Baldwin Park within 30 days.

HELENA, MONT.—The Caird Engineering Company has been given a contract for furnishing light posts for the sum of $6680.

TUCSON, ARIZ.—The city clerk has been instructed by the city council to advertise for bids for ornamental light posts on Congress street and Stone avenue.

TROPICO, CAL.—The board of trustees has awarded the contract for metal street lighting posts along Brand boulevard to the Newbery-Bendheim Electric Company, for $5188 complete.

ANAHEIM, CAL.—The proposition of installing an ornamental lighting system in the business district is to be taken up and pushed with vigor. Practically all interested property owners have signed up for the improvement.

SACRAMENTO, CAL.—Protests against the new method of fixing gas rates in Sacramento proposed in a draft of an ordinance by City Commissioner Charles A. Bliss have been made before the city commission by representatives of both the Sacramento Natural Gas Company and the Pacific Gas & Electric Company.

LOS ANGELES, CAL.—The residents of Huntington Park have started a lighted way from Los Angeles to Long Beach, a distance of about 20 miles. Arrangements are under way to induce the county supervisors to complete the system for the entire length of Long Beach boulevard. Huntington Park lights will start at Alameda and Clauson avenue and call for 98 cast iron posts, surmounted by 16 in. globes.

RIDGEFIELD, WASH.—Franchises for electric lights and a water system were recently granted to J. H. Cunningham, of Portland. Construction on the electric light plant and waterworks will commence as soon as possible and will be rushed to completion. Twelve months are allowed for the completion of the waterworks and eight months for the electric light plant. More time will be required for the completion of the electric light plant, and this work will be expedited as much as possible.

LOS ANGELES, CAL.—The knell of the electric liquor signs, and incidentally a dimming of the Great White Way as it exists in Los Angeles, was officially tolled last week. The electric liquor sign resolution was amended, and made far more drastic and the liquor interests given until July 1st to remove the offending signs. Not only do the signs advertising brands of liquors have to come down, but electric signs "advertising the character of business" will have to be removed. This means that the signs "cafe," "bar," "saloon" and such things that have blazoned a greeting to the thirsty will have to be clothed in darkness.

SAN FRANCISCO, CAL.—The supervisors' lighting committee was advised by City Attorney Long that the City Electric Company was entitled to the contract for furnishing light and power for certain city buildings, as its bid was lower than that of the Pacific Gas & Electric Company. The committee decided to recommend to the Board that the contract be awarded. The Pacific company will be given the contract for gas and electricity for other city uses. The City Electric Company bid 2¼ cents per kilowatt hour for supplying electricity for the city hall, hall of justice, pumping station at Drumm and Commercial streets, corporation yard at 313 Francisco street, and corporation yard at Sixteenth and Harrison streets. The Pacific company's bid was 3 cents for current for lighting and 2½ cents for current for power.

POCATELLO, IDAHO.—One of the most interesting features of the new depot which the Oregon Short Line are constructing here at an expense of $350,000 will be its kitchen equipment which will be electrical throughout. All the mixing, baking, and cooking in this model kitchen will be done by electricity. The only coal used about the building will be for general heating purposes. The decision to go over to electric cooking was made by the Oregon Short Line engineers after a careful investigation of practically all of the large hotel equipments using electricity in Idaho and Utah. It is quite likely that if the installation proves to be as successful as the company's engineers anticipate, that the use of electricity will be extended to their hotel service at many other points in the system. The electric power at this installation is purchased from the Great Shoshone and Twin Falls Water Power Company under a blanket contract between this company and the Oregon Short Line covering its entire system in Idaho reached by the distribution system of the Twin Falls Company.

TRANSMISSION.

SALEM, ORE.—The Rogue River Public Service Corporation has filed an application with the state engineer for a permit to develop power on the headwaters of Rogue River.

SANTA BARBARA, CAL.—Work on construction of a power line to Carpinteria is to begin at once, the Santa Barbara Gas & Electric Company agreeing to complete the line within thirty days.

TULARE, CAL.—The Tulare County Power Company has authorized an issue of $1,000,000 in bonds for extensions. One of the principal developments will be the construction of a new hydroelectric plant in the foothills east of Porterville, for which plans are now being drawn.

LOS ANGELES, CAL.—The finance committee has decided to recommend that $1,500,000 worth of $6,500,000 power bonds be issued. Of this amount $1,250,000 will be used to complete the city's aqueduct power plant in San Francisquito canyon, and installing a transmission line to the boundary lines of Los Angeles, and the remaining $250,000 for preliminary work in connection with condemnation of necessary private distributing systems, etc.

VISALIA, CAL.—The Mt. Whitney Power & Electric Company has connected the pressure pipe with the regulating reservoir at Kaweah No. 3 plant, thereby completing it. The plant has been in operation for over a year, but this regulating reservoir, which was excavated from the steep mountain side in almost solid rock, has been a rather slow operation and has only just been completed. This reservoir will

regulate the daily fluctuations of load. The last of the steam plant extension has also been installed, and the new substations at Exeter, Delano, Strathmore, Earlimart, Terra Bella and Packwood are completed.

LOS ANGELES, CAL.—The state supreme court has affirmed the decision of the Los Angeles superior court in the case of Pinney & Boyle Company versus the Los Angeles Gas & Electric Corporation. The Pinney Company had entered into a contract with the electric company, whereby it was furnished with electricity for power at a certain figure. Subsequently the city of Los Angeles fixed a rate for the electric company to charge its customers which was a higher rate than the Pinney contract rate. Thereupon the electric company demanded of the Pinney Company the higher rate, which the latter refused to pay. Upon this refusal, the electric company refused to deliver electricity to the company. The Los Angeles court favored the electric company on the ground that it was a public utility and could not discriminate between customers.

TRANSPORTATION.

SAN DIEGO, CAL.—Bids of the San Diego Electric Railway Company for franchises on F and Laurel streets have been accepted by the city council. The F street franchise is for the operation of a line from Third to Arctic. The Laurel street franchise is from Fifth to First street.

OGDEN, UTAH.—P. D. Kline of the Ogden Rapid Transit Company states that the contracts for all materials for the construction and operation of an electric extension into Cache Valley, have been let and that building operations are progressing in Cache county, extensions being both north and south of Logan. The contracts include ties, rails, cars and appurtenances.

DIXON, CAL.—Rails are being laid from the south towards Dixon on the first unit of the Sacramento Valley Electric railroad of twelve miles from the junction with the Oakland, Antioch & Eastern to Dixon and the grading has been completed to the outskirts of this city. With the completion of the long bridge across the slough near the Brown place, tracklaying on the remaining eight miles will progress rapidly.

FRESNO, CAL.—Plans for the extension of the Fresno Interurban Railway became known when J. B. Rogers, president of the Fresno Interurban, admitted that he had received offers of substantial bonuses from owners of property in the Gould Colony and west of Blackstone avenue to extend the new electric railroad to and through that property. The proposal calls for the extension of the line along Fresno avenue to Mahoney avenue, and thence along or parallel to Mahoney avenue to or near Blackstone avenue, and through the Gould Colony. The distance from where the line now ends on Fresno avenue to the proposed terminus in the Gould Colony is approximately 2½ miles.

SAN FRANCISCO, CAL.—The Mercantile Trust Company began suit in the superior court last week against the defunct Geary Street, Park & Ocean Railroad Company, (the old Geary street cable road), for the foreclosure of the mortgage held by the bondholders on the real estate and securities of the corporation. The action was brought by the trust company as trustee of the deed of trust on outstanding bonds amounting to $484,000. The principal assets of the company consist of the property at Buchanan and Geary streets, on which there was an office building, and the car house at First avenue and Geary street. It is set forth that the assets will not amount to more than $270,338.01, while the liabilities are $326,000.

LOS ANGELES, CAL.—A major surgical operation, by which two parallel lines of railroad are to be made one, and trackage abandoned whose initial cost was $1,200,000 was decided on at a conference in this city between officials of the Las Vegas and Tonopah, and Tonopah & Tidewater Railways, which was the Bullfrog & Goldfield. The two roads were built when the Goldfield-Tonopah district was in full bloom, but when the mines began to show disintegration, it was found that one line was not really needed. As now planned, it is stated that about half of the roads between Goldfield and Beatty will be abandoned, and the remaining segments hooked together. The ownership of the new road is a knotty problem, not yet fully determined.

SAN FRANCISCO, CAL.—The discussion of the proposed purchase of the United Railroads by the city, before the Commonwealth Club at last week's meeting, developed the fact that valuation will be the final question to be decided, and that it will have to be determined by the rules governing operation of a car system. President Lilienthal reiterated the statement that he believed the only satisfactory solution of the transportation problem was for the city to purchase the properties of the United Railroads. He instanced the charter limitations that made it impossible to interest outside capital upon which the company was dependent for extensions and improvements to its system. He then cited the following figures: Gross earnings of the United Railroads for 1914, $8,750,000; expenses, $4,900,000; net earnings, $3,850,000. While he did not carry out this mathematical problem, engineers in the audience were quick to see that was 5 per cent interest upon approximately $77,000,000. Continuing in the same strain, Lilienthal said that if the same ratio were continued for earnings and increase in population for the remainder of the term of the company's franchises, the gross earnings would amount to $306,000,000, the expenses would amount to $198,900,000, leaving an estimated net balance for stock and bond holders to amount of $107,000,000.

TELEPHONE AND TELEGRAPH.

DOUGLAS, ARIZ.—Construction of a telegraph line from Bavispe River towns to Oaxaca and Nacozari is proposed by the Sonora state government for the immediate future. Proposed owners along the line, approximately 150 miles, have been notified to purchase and set up poles.

ALAMEDA, CAL.—Refusing to accept a 20 year franchise in return for 2 per cent of its gross receipts and 40 free telephones, the Pacific States Telephone & Telegraph Company has asked the city council for a 25 year franchise. The company promises to give the 2 per cent demanded, which, it is estimated, will total $70,000 for the quarter century; 20 free phones, which is estimated to be worth $36,750; contracts for poles and fire alarm wires, $5000; not to charge for service given free since the old franchise expired, amounting to $2500 and to give the city $2900 as the 2 per cent of the revenue since the old franchise expired.

WATERWORKS.

SANTA CRUZ, CAL.—The council voted to call a bond election for $150,000 for the purpose of extending the municipal water system.

PARIS, IDAHO.—An ordinance has been passed providing for the issuance of $4000 worth of municipal coupon bonds for the construction of municipal waterworks.

BILLINGS, MONT.—An election will be held June 27th to vote on a bond issue in the sum of $450,000 to buy the present water plant and make needed improvements.

EUGENE, ORE.—Coburg has issued $13,500 worth of bonds to buy the water system and to extend the mains. The bonds have been awarded to the Eugene Loan & Savings Bank.

YUBA, CAL.—The contract for the pumping plant for Reclamation District No. 1001 has been awarded by the trustees of the district to the Electric & Machine Equipment Company of Stockton for $35,799.

GLENDALE, CAL.—A recent mass meeting of Glendale citizens resulted in the adoption of a resolution to call an election to vote bonds in the sum of $165,000, the aggregate cost of the present water plants of Glendale, for the purchase of the plants.